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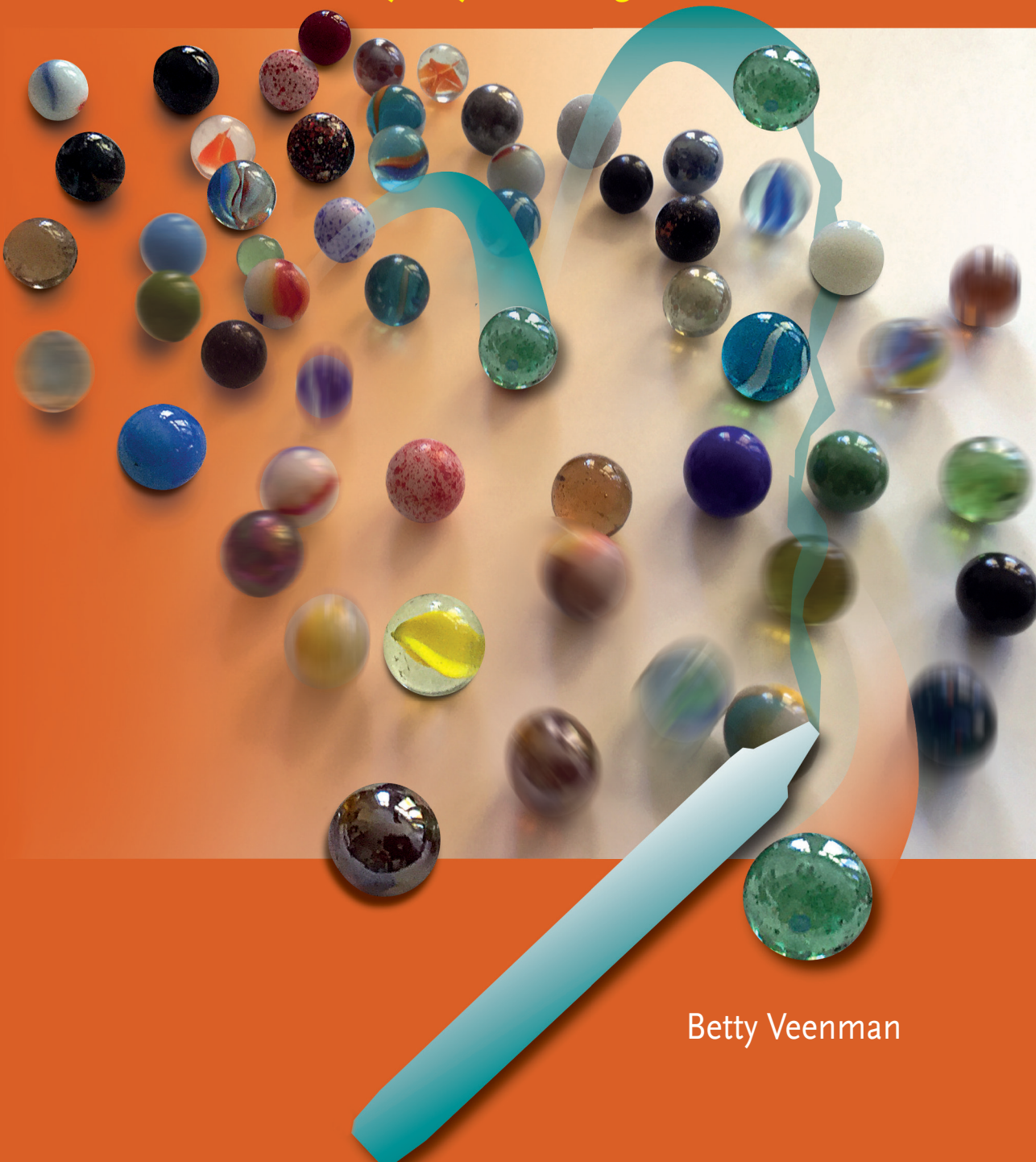
Positivity & Rules

A classy way to manage ADHD behavior



Betty Veenman

POSITIVITY&RULES
A Classy Way to Manage ADHD Behavior

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2018

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VRIJE UNIVERSITEIT

POSITIVITY & RULES PROGRAM
A Classy Way to Manage ADHD Behavior

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CHAPTER 1 General Introduction

Introduction

Attention-deficit hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorders that affects an estimated 5% of all children (Polanczyk, de Lima, Horta, Biederman, & Rohde, 2007). ADHD is characterized by pervasive and inappropriate levels of hyperactivity, impulsivity and/or inattention, resulting in a daily impairment (American Psychiatric Association, 2013). Children with ADHD also often display social problems, comorbid disorders including oppositional defiant disorder (ODD), conduct disorder (CD), and anxiety disorders (Rommelse et al., 2009), and have an increased risk for adverse life events such as occupational and relational difficulties, drug abuse, and delinquency (Molina et al., 2007; Shaw et al., 2012).

Another 10% of all school-aged children reveal ADHD symptoms without meeting full diagnostic criteria, while experiencing similar, but milder difficulties and risks as children with clinical ADHD (Hong et al., 2014; Willcutt, 2012). Viewing ADHD as a continuum has, therefore, been argued to do more justice to the variation in severity of ADHD symptoms than the categorical approach neglecting symptom severity. The dimensional approach of ADHD is also supported by several genetic, neuropsychological and behavioral studies, revealing similar but milder deficits in non-clinical ADHD samples compared to clinical ADHD studies (Hay, Bennett, McStephen, Rooney, & Levy, 2004; Polderman et al., 2007; Sonuga-Barke, Dalen, Daley, & Remington, 2002). Therefore, it might be more appropriate to view ADHD behavior as a continuum rather than a dichotomy, with low levels of inattention, hyperactivity and impulsivity on one end and severe, inappropriate levels of ADHD symptoms on the other end (Lubke, Hudziak, Derks, van Bijsterveldt, & Boomsma, 2009). Early support for all children with ADHD symptoms is essential to prevent an escalation of problem behavior (Kutcher et al., 2004). The focus of this dissertation was to examine the effectiveness of a low-intensive behavioral teacher program for children displaying high levels of ADHD symptoms in the classroom, regardless of meeting full diagnostic ADHD criteria.

Problems at School

At school, children with ADHD symptoms often experience a wide variety of problems. First, common behavioral problems are off-task behavior (due to inattention or reduced sustained attention), disruptive behavior (e.g. being noisy due to hyperactivity or interrupting the teacher due to impulsivity), and teacher disobedience, particularly in case of co-occurring conduct problems (Diamantopoulou, Rydell, Thorell, & Bohlin, 2007; Wilens et al., 2002).

Furthermore, ADHD symptoms seem to contribute to academic impairments such as poor reading and mathematical skills (Daley & Birchwood, 2010). Problems with peers are also very common in children with ADHD symptoms. They are more often rejected by peers, have few mutual friends and have difficulties maintaining friendships (Hong et al., 2014; Hoza, 2007). This unpopularity amongst peers can also result in more loneliness and a low self-esteem (Ladd & Troop Gordon, 2003; Wheeler & Carlson, 1994). Overall, these behavioral, academic and peer problems of children with ADHD symptoms increase the likelihood of receiving negative feedback from teachers and peers, thus emphasizing the child's problems and possibly even aggravating the problem behavior (Hoza, 2007).

Neurocognitive Deficits

Several neurocognitive problems have been associated with ADHD, most importantly executive dysfunction, reduced vigilance/sustained attention, timing problems and motivation deficits (Nigg, 2005; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Milder neurocognitive problems have also been found in children not meeting full diagnostic ADHD criteria (Faraone, Biederman, Doyle et al., 2006; Hong et al., 2014). Executive functioning (EF) refers to the ability to exert top-down control over behavior and is thus essential for goal-directed, intentional behavior. EF encompasses functions such as inhibition (e.g. ability to suppress conflicting irrelevant information), working memory and planning (Zelazo, 2015). Examples of the executive dysfunction of children with ADHD symptoms are difficulty awaiting turns (inhibition), remembering instructions from teachers (working memory) and planning their week task. The reduced vigilance observed in children with ADHD symptoms makes it difficult for these children to concentrate on school tasks or listen to teacher instructions, particularly when given to the entire classroom at once (Imeraj et al., 2013). Timing problems associated with ADHD can result in difficulties for children with ADHD symptoms to estimate how long it takes to perform (school) tasks (Coghill, Seth, & Matthews, 2014). An example of the motivational deficits of children with ADHD symptoms is their avoidant behavior when they need to start working on unfavorable or difficult school tasks. These motivational deficits appear to be related to a deviant sensitivity to positive reinforcement in children with ADHD: these children are less sensitive to delayed rewards and need a high frequency of rewards to reinforce appropriate behavior (Luman, Tripp, & Scheres, 2010; Sagvolden, Johansen, Aase, & Russell, 2005; Tripp & Wickens, 2009).

While all children with ADHD symptoms may benefit from behavioral programs, such programs might be more helpful for those experiencing neurocognitive problems. For example, more structure and clear rules can help these children understand which behavior is expected from them, and rewards (e.g. compliments and privileges) can be an extra motivation to display the desired behavior.

Treatment of ADHD

Currently, there are two types of evidence-based treatments for ADHD: psychostimulant medication and behavioral programs (Sibley, Kuriyan, Evans, Waxmonsky, & Smith, 2014; Van der Oord, Prins, Oosterlaan, & Emmelkamp, 2008b). Psychostimulant medication is often used as first-line treatment and has proven to be effective in reducing symptoms of ADHD, ODD and CD (Atkinson & Hollis, 2010). However, a substantial group of children (20-30%) are non-responders or suffer from adverse side effects such as insomnia or loss of appetite (Kutcher et al., 2004; Swanson, McBurnett, Christian, & Wigal, 1995). In addition, long-term adherence to medication intake is often not accomplished and the evidence for long-term effects of stimulant medication is scarce (Parker, Wales, Chalhoub, & Harpin, 2013).

Behavioral programs also effectively reduce symptoms of ADHD, ODD and CD, as well as social functioning (Comer, Chow, Chan, Cooper-Vince, & Wilson, 2013), and are advised as first-line treatment for mild to moderate ADHD (Atkinson & Hollis, 2010). Another advantage of behavioral programs is that they are more often accepted by teachers and parents than medication (Pelham et al., 2007; Pisecco, Huzinec, & Curtis, 2001).

Effects of behavioral programs are often smaller than those of psychostimulant medication, but combining both treatments appears most effective (Pelham, Burrows-MacLean et al., 2005). In fact, lower medication doses seem sufficient when a behavioral program is also used (Vitiello et al., 2001). Starting with a behavioral program and adding medication in a later stage appears to be more fruitful than a combined treatment in the reverse order (Pelham et al., 2016).

Behavioral Programs at School

In contrast to behavioral programs for parents or children, behavioral programs at school target a wide group of children at once. As such, behavioral teacher programs could play an important role in preventing an escalation of problem behavior in children displaying ADHD symptoms in the classroom, particularly

for children not meeting full diagnostic criteria. Adequate support for those children is limited and often not covered by private or public insurance. However, behavioral teacher programs often require intensive and expensive training of teachers, which could reduce sustainability of such programs due to financial restraints (Wilson, Lipsey, & Derzon, 2003).

Recently, changes have been made in the Dutch educational system ('Passend Onderwijs'). These changes oblige schools to provide additional assistance to all children in need of extra care (e.g. children with psychiatric or learning disabilities), thus reserving special education services for those children who really need it (OCW, 2006). This has increased pressure on primary school teachers. They have the huge responsibility to educate large groups of children (class sizes of 30 students are not uncommon) of which several children need special attention due to, for example, psychiatric problems such as ADHD. In addition, many teachers report insufficient knowledge about ADHD and how to target ADHD symptoms adequately in the classroom (Moldavsky & Sayal, 2013; Rose, Gallup, Welburn, & Hess, 2005). Behavioral teacher programs targeting ADHD symptoms in the classroom, could thus assist teachers to increase their self-efficacy and regain self-control in the classroom, allowing them to focus on teachers' primary goal: education.

The Positivity & Rules program (PR program), a manualized behavioral program targeting ADHD symptoms in the classroom, can be used by the teacher without additional training (Veenman, Luman, Hoeksma, Pieterse, & Oosterlaan, 2016). This 18-week behavioral program comprises the most essential elements of other evidence-based behavioral programs (e.g. the Summer Treatment Program; MTA Cooperative Group, 1999), such as psycho-education, classroom management techniques, and behavioral techniques (reward and time-out system for all classmates, and Daily Report Card for individual hyperactive/impulsive and inattentive children; Kaminski, Valle, Filene, & Boyle, 2008). The low intensity and low costs of the PR program provide the opportunity of wide-scale implementation and could reduce the use of expensive individual programs or special education programs if the program proves to be effective.

Meta-analytic literature indicates positive effects of behavioral teacher programs for students with ADHD symptoms (Gaastra, Groen, Tucha, & Tucha, 2016). However, there are only two randomized controlled trials (RCTs) investigating the effects of unimodal behavioral programs for primary school teachers of students with ADHD (Fabiano, et al., 2010; Miranda, Presentación, & Soriano, 2002). One of those RCTs found beneficial program effects on teacher-rated

ADHD symptoms (Miranda et al., 2002) and both found positive effects on teacher-rated conduct problems (Fabiano et al., 2010; Miranda et al., 2002). One of the two RCTs using less-proximate measures of child functioning also reported positive effects on parent-rated ADHD symptoms and antisocial behavior (Miranda et al., 2002).

Aims of Current Dissertation

The main aim of this dissertation was to examine the effectiveness of the PR program. To obtain a comprehensive view of the program's effectiveness, proximate and less-proximate effects (teacher ratings versus classroom observations, actigraphy, and peer ratings) were assessed, as well as the moderating effects of the program on ADHD symptoms and social functioning.

As children with ADHD often experience extensive peer problems, another important aim of this study was to investigate multiple aspects of peer problems in children with high levels of ADHD symptoms. This study extends on previous literature by using an elaborate set of peer measures, including social preference and impact, number of dyadic friendships, level of imbalance and sociometric scores of nominated and nominating peers, while also exploring whether the separate dimensions of ADHD symptoms (i.e., hyperactivity/impulsivity and inattention), conduct problems, emotional problems and prosocial behavior were related to these peer problems.

Study Design

This dissertation describes a randomized controlled trial testing the effectiveness of the PR program. The trial was carried out in the Netherlands between September 2011 and July 2014. Participants were 114 children (aged 6 and 13 years) who attended regular primary school and displayed elevated levels of ADHD symptoms in the classroom. Children were randomly allocated at school level to the intervention (PR program; $n = 58$) or control group ($n = 56$) in which care as usual could be received. Inclusion criteria were: high levels of ADHD symptoms in the classroom based on a teacher questionnaire (Disruptive Behavior Disorders Rating Scale; Oosterlaan et al., 2008) and a semi-structured teacher interview comprising all diagnostic ADHD criteria (Teacher Telephone Interview; Holmes et al., 2004), estimated IQ>80, no ADHD treatment at study entry or in the preceding 6 months, no neurological or severe physical condition interfering with daily functioning, and not being enrolled in a daily contingency management program or another teacher program addressing behavior or social problems at study entry or in the preceding month.

Outcome variables that assessed effects of the PR program were teacher and parent ratings, classroom observations, actigraphy, and peer ratings of behavioral, social and emotional functioning. Assessment took place one week prior to the intervention (T_0, baseline measurement), six weeks after the start of the intervention (T_1), and at the end of the intervention (T_2, eighteen weeks after it started). Program effects were assessed using intention-to-treat multilevel analyses, with Group, Time and Group x Time as fixed factors.

Outline of Current Dissertation

Chapter 2 involves a meta-analysis of RCTs to investigate the effectiveness of existing behavioral teacher programs on disruptive behavior (symptoms of ADHD, ODD and CD). As the PR program consists of classroom management and contingency management techniques regularly used in similar behavioral teacher programs, this chapter can be regarded as the theoretical foundation of the PR program. Instead of focusing on ADHD symptoms, this review also included ODD and CD symptoms, because of the high comorbidity between these disruptive behaviors (Rommelse et al., 2009) and the fact that behavioral classroom interventions adequately deal with both ADHD and ODD/CD symptoms (Kutcher et al., 2004; Pfiffner, 2014).

In **chapter 3**, effects of the PR program on behavior, social and emotional functioning were examined based on the experiences of teachers and parents. **Chapter 4** elaborates on the previous chapter by assessing program effects through classroom observations, actigraphy and peer ratings. As teachers and parents might be biased due to high expectations of the program and/or involvement in treatment delivery, these less-proximate measures are important for a more comprehensive view on the effectiveness of the program. **Chapter 5** explored possible moderators of the effectiveness of the PR program at the child level (a.o. age, gender, severity of problem behavior) and at the classroom level (years of teacher experience and class size). Identifying moderators of treatment outcomes may help to gain further understanding of a program's effectiveness, which could help clinical practitioners to individualize treatment options depending on patient characteristics and other relevant circumstances.

In **chapter 6**, peer problems in children with ADHD symptoms were examined using an elaborate set of peer measures. This allowed us to obtain a more comprehensive view of peer problems in children with ADHD symptoms compared to existing literature. The second aim of this study was to assess whether those peer problems were associated with ADHD symptom dimensions

(inattention and hyperactivity/impulsivity), conduct problems, emotional problems and prosocial behavior. If substantial peer problems in children with ADHD symptoms are found, this highlights the importance of improving the social skills of children with ADHD symptoms, for example through peer-based interventions fostering prosocial behavior.

Chapter 7 provides a summary and general discussion, in which clinical implications of the findings, strengths and limitations of the conducted research, as well as ideas for future research are addressed. The aims of the chapters of this dissertation are visualized in Figure 1.

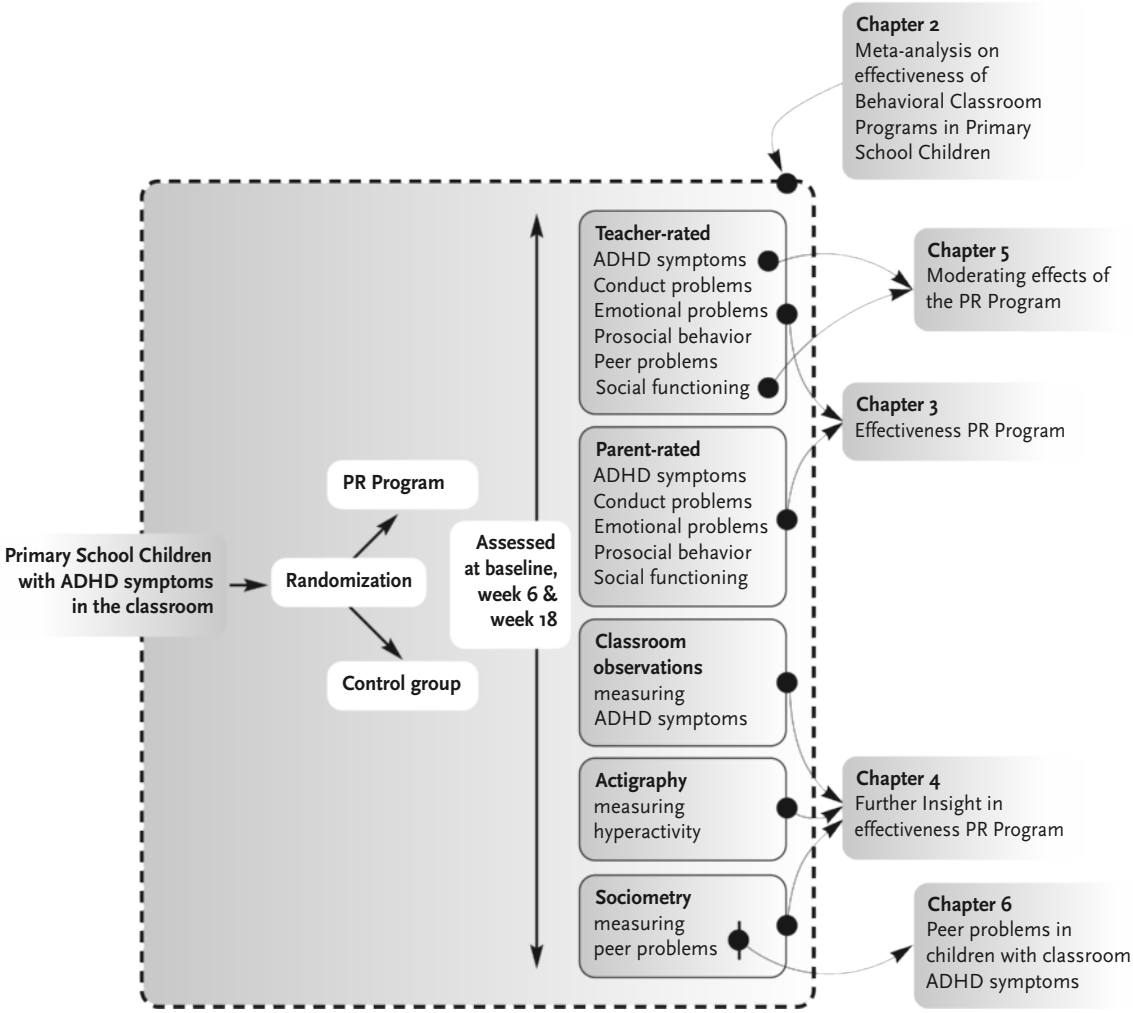

Figure 1. Schematic overview of the study design and chapters of this dissertation

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CHAPTER 2 Efficacy of Behavioral Classroom Programs in Primary School.

A Meta-Analysis Focusing on Randomized Controlled Trials.

ABSTRACT

Objective

This meta-analysis evaluated the efficacy of behavioral classroom programs on symptoms of Attention-deficit Hyperactivity Disorder or Oppositional Defiant and/or Conduct Disorder in primary school children.

Methods

Online database searches (in PubMed, Embase, Psycinfo, and Eric) yielded nineteen randomized controlled trials (N = 18,094), comparing behavioral classroom programs (including multimodal programs involving a classroom program) to no treatment or treatment as usual. Random-effects meta-analyses were conducted for teacher-rated and classroom-observed disruptive classroom behavior and for classroom-observed on-task behavior. Post-hoc analyses investigated whether effects depended on type and severity of problem behavior. Meta-regressions were used to study the moderating effects of age, gender, and intervention duration.

Results

Small positive effects were found on teacher-rated disruptive behavior (d = -0.20) and classroom-observed on-task behavior (d = 0.39). Program effects on teacher-rated disruptive behavior were unrelated to age, gender, type and severity of problem behavior, but negatively associated with intervention duration (R^2 = 0.43).

Conclusion

Behavioral classroom programs have small beneficial effects on disruptive behavior and on-task behavior. Results advocate universal programs for entire classrooms to prevent and reduce disruptive classroom behavior.

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Efficacy of Behavioral Classroom Programs in Primary School. A Meta-Analysis Focusing on Randomized Controlled Trials. *Plos One.*

INTRODUCTION

Attention-Deficit Hyperactivity Disorder (ADHD) and Disruptive Behavior Disorders are some of the most common psychiatric disorders in children (Forness, Freeman, Paparella, Kauffman, & Walker, 2012; Kessler, et al., 2012) and comorbidity between these disorders is very substantial (Wilens et al., 2002). The main characteristics of ADHD are hyperactivity-impulsivity and inattention (American Psychiatric Association, 2013). Disruptive Behavior Disorders can be subdivided into Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD). Main characteristics of ODD and CD are negativism, hostility, and disobedience towards authority figures, while aggression and serious violation of the basic rights of others are essential to CD (American Psychiatric Association, 2013). Children with externalizing behavior problems often display disruptive behavior in school, such as talking aloud, disobedience and off-task behavior (Hunter, 2003). Moreover, these children have a high risk of academic underachievement and school dropout (Lane, 2007; Wentzel, 1993). Externalizing behavior problems are further associated with peer problems and family dysfunction as well as adverse events later in life, such as work-related problems, substance abuse and antisocial behavior (Loeber, Burke, Lahey, Winters, & Zera, 2000; Shaw, et al., 2012). Given the impairments and adverse outcomes associated with disruptive behavior, interventions at an early age are crucial to prevent escalation of problem behavior later in life.

Medication is commonly used to effectively reduce the core symptoms of ADHD and to reduce severe and persistent aggression. However, 20-30% of children with ADHD using psychostimulants fail to show symptom improvements or suffer from adverse side effects, such as insomnia, headache or loss of appetite (Kutcher et al., 2004; Swanson et al., 1995) and the evidence for long-term effects of stimulant medication is limited (Parker et al., 2013). Besides that, medication is discouraged as treatment for ODD and CD, except for cases showing severe aggression (Kutcher et al., 2004). Therefore, non-pharmacological interventions are needed that effectively reduce disruptive behavior. A meta-analysis comparing effects of behavioral and non-behavioral interventions (all predominantly family-based), showed highest effect sizes for behavioral therapy on externalizing behavior problems such as ADHD, ODD and CD (Comer et al., 2013). As children with externalizing behavior problems frequently display disruptive behavior at school (Hunter, 2003) and schools have the advantage of reaching nearly all children, school-based behavioral interventions may provide a very important lead to the treatment of disruptive behavior.

Behavioral programs are often used at school to address disruptive classroom behavior. The majority of these programs use antecedent techniques to prevent behavioral problems (e.g. by clear rules and effective instructions) and consequent techniques to reinforce appropriate behavior and reduce inappropriate behavior (e.g. by reward systems and time-out systems). The Summer Treatment Program, for example, contains a behavioral classroom program for children with ADHD, in which positive reinforcement is used within classroomsettings and during activities outside the classroom, such as during sports (MTA Cooperative Group, 1999). The Good Behavior Game is another example of a widely-used group behavioral program, in which small groups of students are rewarded for the behavior of one or more students in their group (Tingstrom, Sterling-Turner, & Wilczynski, 2006).

Several reviews and meta-analyses have addressed the efficacy of behavioral classroom programs on disruptive behavior and on ADHD symptoms in particular (DuPaul & Eckert, 1997; DuPaul, Eckert, & Vilardo, 2012; DuPaul & Weyandt, 2006; Evans, Owens, & Bunford, 2014; Fabiano et al., 2009; Gaastra et al., 2016; Goh & Bambara, 2010; Hunter, 2003; Maggin, Johnson, Chafouleas, Ruberto, & Berggren, 2012; Pfiffner, 2014; Schultz, Storer, Watabe, Sadler, & Evans, 2011; Stage & Quiroz, 1997; Tingstrom et al., 2006; Wilson & Lipsey, 2007; Wilson et al., 2003). Unfortunately, none of the available reviews and meta-analyses focused specifically on classroom-based behavioral programs and none focused exclusively on randomized controlled trials (RCTs), which are regarded as the gold standard due to a minimization of biases and possibly confounding factors (Jüni, Altman, & Egger, 2001; Kantowitz, Roediger III, & Elmes, 2014; Kazdin, 2003). Therefore, it is difficult to draw firm conclusions regarding the effects of behavioral classroom programs on disruptive behavior within the classroom and the potential moderators influencing these effects. The meta-analysis of Fabiano and colleagues (Fabiano et al., 2009), for example, investigated the effectiveness of behavioral treatments for children with ADHD and reported behavioral programs to be highly effective (unweighted effects being 0.83 in between-group studies, 0.70 in pre-post studies, 2.64 in within-group studies, and 3.78 in single subject studies). The large difference reported in that meta-analysis between the effect size for single subject designs (3.78) and that for between-group studies (0.83) demonstrates how study design can result in inflated effect sizes and thus highlights the importance of RCTs. Unfortunately, only 20 of the 174 studies (11%) included in the meta-analysis of Fabiano and colleagues (Fabiano et al., 2009) involved between-group designs and it is unclear if any of those studies were RCT's. Besides that, only one fourth of the

twenty between-group studies involved classroom programs and effects are not reported for classroom behavioral program separately. The meta-analysis of Maggin and colleagues (Maggin et al., 2012) did investigate the effects of classroom programs, but included only group contingency programs (i.e., programs in which groups of students receive a reward based on the behavior of one or more students of that group) instead of focusing on all types of classroom behavior programs. Another recent meta-analysis (Gaastra et al., 2016) has investigated the effects of all types of behavioral classroom programs on disruptive classroom behavior for children with symptoms of ADHD. Results of that meta-analysis showed reductions of off-task behavior and of disruptive classroom behavior (standardized mean differences being 0.92 for within-subject designs and 3.08 for single-subject designs), but that meta-analysis did not include any studies using between-subjects designs and thus no RCTs either. Hence, based on the available literature, it is difficult to draw firm conclusions regarding the specific effects (and effect sizes) of behavioral classroom programs on disruptive behavior within the classroom.

Our study contributes to the literature with a comprehensive quantitative meta-analysis of all available RCTs into the effects of behavioral classroom programs in primary school, including multimodal programs that involve a behavioral classroom program. Our focus was on disruptive behavior in the classroom, as assessed by teachers and classroom observations, and on classroom-observed on-task behavior. Based on earlier work, significant intervention effects were expected for disruptive behavior rated by teachers as well as independent classroom observations (Daley et al., 2014). However, for the classroom-observed outcomes, effects might be smaller as classroom observers are less likely to be biased than teachers who are directly involved in the delivery of treatment (see Sonuga-Barke et al., 2013 for a review on this issue). It was also assessed whether effects of behavioral programs depended on the type of problem behavior (ADHD and ODD/CD symptoms) and on severity of problem behavior (by comparing clinical, at-risk, and community samples). Symptoms of ODD and CD were taken together because ODD and CD show resemblance in terms of phenotypical manifestation, high comorbidity, substantial overlap in risk factors associated with both disorders, and similarities in terms of effective treatments (Lahey & Waldman, 2012; Loeber, Burke, & Pardini, 2009; Rowe, Maughan, Pickles, Costello, & Angold, 2002). Previous studies have suggested better response to behavioral programs for oppositional problems compared to ADHD symptoms and for more severe problem behavior compared to less severe problem behavior (Comer et al., 2013; Daley et al., 2014; Lundahl, Risser,

& Lovejoy, 2006). Therefore, larger effects were expected for ODD/CD symptoms than for ADHD symptoms and for samples with more severe problem behavior (clinical and/or at-risk samples compared to community samples). The potential moderating effects of gender, age and intervention duration on outcome were assessed to identify for whom and under which conditions behavioral programs would be most effective. The evidence for possible moderating effects of gender is inconclusive as some studies report no moderating effects of gender (Enebrink, Högström, Forster, & Ghaderi, 2012; MTA Cooperative Group, 1999), while others reveal superior treatment effects for boys (Kellam, et al., 2008; Witvliet, van Lier, Cuijpers, & Koot, 2009). The moderating effect of age is also inconclusive as meta-analyses on the efficacy of psychosocial interventions reveal inconsistent results (Comer et al., 2013; Lundahl et al., 2006). With regard to intervention duration, a positive association was expected with treatment efficacy, since more lengthy programs may result in better treatment response (Pelham Jr, Wheeler, & Chronis, 1998; but see also Van der Oord et al., 2008b).

METHODS

This meta-analysis was performed in conformity with the guidelines provided by the PRISMA group (Preferred Reporting Items for Systematic Reviews and Meta-Analysis; Moher, Liberati, Tetzlaff, & Altman, 2009).

Study Selection and Description

This meta-analysis included efficacy studies on behavioral classroom programs that met the following inclusion criteria: (1) the study was a randomized controlled trial assessing the effects of behavioral classroom programs compared to 'no care' or 'care as usual'. Behavioral programs were defined as programs using behavioral techniques on a daily basis (e.g. token economy). To incorporate all available RCTs on the efficacy of behavioral classroom programs in this meta-analysis, more comprehensive treatment programs (e.g. multimodal programs or those involving additional cognitive behavioral elements) that used a behavioral classroom program as one of the main elements were also included; (2) the study included one of the following outcome measures: (a) disruptive classroom behavior (i.e. symptoms of ADHD, ODD/CD, or a combination of those symptoms) as assessed by validated teacher ratings or classroom observations by an independent rater, or (b) classroom-observed on-task behavior. Studies that only assessed disruptive behavior at the classroom level (e.g. total of discipline referrals in the entire classroom) rather than disruptive behavior of individual children were not included; (3) the study included predominantly elementary school children as

participants (6-12 years old on average) in regular education or school-related settings, regardless of severity of problem behavior (thus including community samples, children at risk for and children with clinical externalizing behavior disorders) and (4) the study was published between 1980 and 1st of July 2016 in an English-language peer-reviewed journal, which is in accordance with the emergence of the third version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III; Spitzer, Md, & Williams, 1980). Studies were excluded if: (1) the study focused on children with psychiatric or neurological problems other than ADHD or ODD/CD (e.g. autism or epilepsy); (2) the study solely focused on the enhancement of concentration problems or only on disruptive behavior outside the classroom, such as playground aggression or bullying, since such studies did not target disruptive classroom behavior (e.g. Reid, Eddy, Fetrow, & Stoolmiller, 1999; Waasdorp, Bradshaw, & Leaf, 2012) or (3) if there were insufficient data to calculate effect sizes (e.g. if only mean and sample size were available, but no standard deviation or standard error). Despite our attempt to obtain the missing data necessary for effect size calculation, two studies were excluded based on this third exclusion criterion (Forman, 1980; Van Lier, Muthén, van der Sar, & Crijnen, 2004). If multiple articles were published using the same sample, we selected the most comprehensive report on that study with the largest sample size or the most encompassing assessment of disruptive classroom behavior. Characteristics of the individual studies included in this meta-analysis (including dependent variables and test statistics) are depicted in Table 1.

To identify relevant articles for this meta-analysis, the electronic databases PubMed, Embase, Psycinfo and Eric were searched. Search terms and equivalent mesh terms describing participants' problem behavior (e.g. 'disruptive behavior', 'externalizing problems', 'attention deficit hyperactivity disorder', 'oppositional defiant disorder', 'conduct disorder', 'aggression') were combined with the term 'classroom interventions' and related terms (e.g. 'teaching method'), which were applied to both titles and abstract (see Supplement 1 for the search terms used in the database PubMed). Reference lists of the selected articles were checked to identify additional relevant studies. To determine eligibility of retrieved articles, we first assessed all inclusion and exclusion criteria on the basis of title and abstract and, if necessary, on the basis of the full-text articles. In case of doubts regarding inclusion and exclusion criteria, authors were contacted to clarify those issues. Eventually 19 articles were included in this meta-analysis.
A flow diagram of identification, screening and inclusion of studies is depicted in Figure 1.

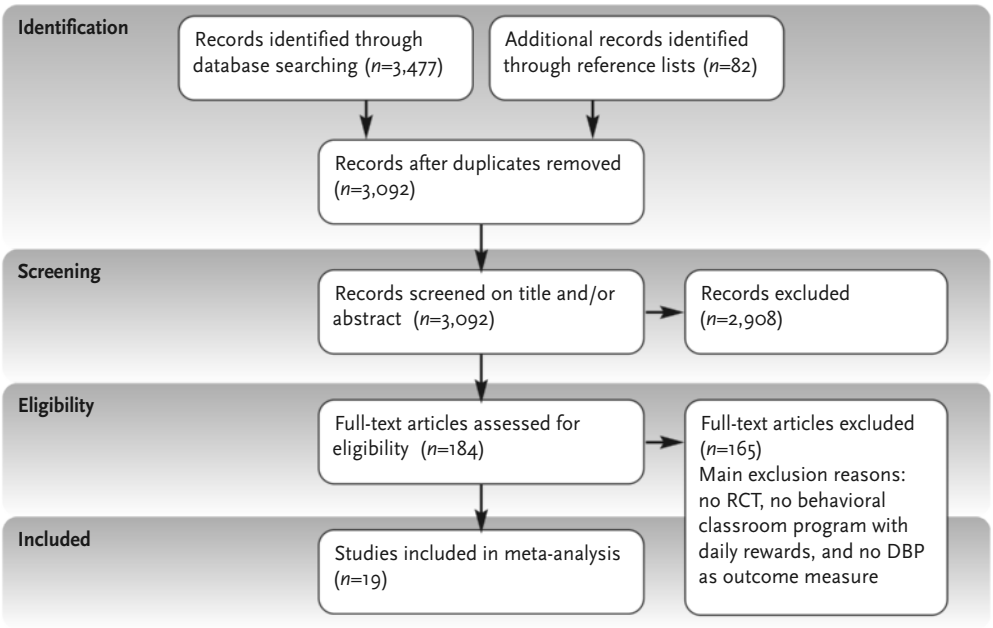

Figure 1. PRISMA flow diagram of studies through the review process.

Randomization level	Sample, inclusion and exclusion criteria	Age range / grade range at T_0	Intervention duration and elements of treatment and control arm
1. Atkins et al., 2006: Positive Attitudes toward Learning in School (PALS)			
Randomization at classroom level	• *N* = 90 48 boys; 42 girls • Clinical EBD score based on EBD rating scale • No exclusion criteria	Kindergarten – Grade 4	• 1 year • Treatment arm: mainly BP, but also CB, social skills and peer tutoring; multimodal: also parent component • Control arm: care as usual
2. Atkins et al., 2015: Links to Learning			
Randomization at school level. Schools were of similar size and in similar proximity to participating mental health services	• *N* = 171 124 boys; 47 girls • Clinical EBD score based on EBD rating scale (T or P) • No exclusion criteria	Kindergarten – Grade 4	• 3 years • Treatment arm: BP, peer tutoring, and Good News Notes (positive feedback to parents): also parent component (but only for 8 weeks) • Control arm: care as usual
3. Bradshaw, Waasdorp & Leaf, 2012: School-Wide Positive Behavioral Intervention and Supports (SWPBIS)			
Randomization at school level, with schools being matched at baseline demographics (e.g. school enrollment)	• *N* = 12,344 6,482 boys; 5,782 girls • Community sample • No exclusion criteria	Kindergarten – Grade 2	• 4 years • Treatment arm: BP (school-wide = universal program) • Control arm: waitlist group not receiving intervention during assessment period

Definitions and Outcome Measures

Primary analyses focused on disruptive behavior and on classroom-observed on-task behavior. Disruptive behavior was defined as externalizing behavior problems including hyperactivity/impulsivity, oppositional behavior, and aggression (see Table 1 for an overview of the instruments assessing disruptive behavior). For studies reporting several disruptive outcome measures (e.g. ADHD and ODD/CD symptoms), disruptive behavior was measured as a combination of those outcomes by calculating the standardized mean differences and variances for each pertinent subscale and subsequently averaging these scores (assuming a correlation of 1 between the aggregated subscales to yield a conservative estimate; Borenstein, Hedges, Higgins, & Rothstein, 2011). On-task behavior was defined as academic engagement time (AET; mostly measured as the percentage of AET during an interval of 15 minutes; see Table 1).

Table 1. Randomized controlled trials on the effectiveness of behavioral classroom programs on disruptive and off-task behavior

	Parameters used for effect size calculation and other relevant statistical information	Outcome measures and instruments used for effect size calculation	Study quality[a]
	• Parameters: *r* and *N* for T_0 (baseline) and T_1 (1 year), controlling for pretest scores • Baseline differences: none • Special remarks: the data of cohort 1 was used since only this cohort received BP. The statistic *r* corresponded to the intensity of the school intervention and was based on the number of times advise was given and its duration.	Outcome measures: • DBP: CRS (T) • ADHD: n.a. • ODD/CD: n.a. • On-task behavior: n.a.	1
	• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (6 months) • Baseline differences: off-task: intervention > control • Special remarks: none	Outcome measures: • DBP: SDQ (T) • ADHD: n.a. • ODD/CD: n.a. • On-task behavior: BOSS Engagement	3
	• Parameters: *t* and *N* for T_0 (baseline) and T_5 (4 years), controlling for several school-level and student-level variables (including gender and grade cohort) • Baseline differences: none • Special remarks: special education status (proxy of severity of problem behavior) did not moderate results	Outcome measures: • DBP: TOCA-C, average of ADHD and ODD/CD (T) • ADHD: TOCA-C, concentration scale (T) • ODD/CD: TOCA-C, aggression scale (T) • On-task: n.a.	2

Randomization level	Sample, inclusion and exclusion criteria	Age range / grade range at T_0	Intervention duration and elements of treatment and control arm
4. Braswell et al., 1997: Multicomponent Competence Enhancement Intervention (MCEI)			
Randomized block design[b], with school districts as blocks that were matched on SES, reading achievement and school size	• *N* = 309 247 boys; 62 girls • At risk for EBD based on teacher and parent rating (CRS-HI) • Exclusion criteria: IQ-score < 80, educational placement in program for pervasive developmental disorder or severe EBD	Grade 1 – 4	• 2 years • Treatment arm: BP, CB and social skills; multimodal: also parent and child component • Control arm: information/attention control group of low intensity (max 12 hours per year, but >50% attended no sessions or 2-6 hours)
5. Cheney et al., 2009: Check, Connect, & Expect (CCE)			
Randomized block design[b], with schools as blocks that were matched on school size, % of students with IEPs, % students receiving free lunch, and % of Caucasian students	• *N* = 207 152 boys; 55 girls • At risk for EBD based on teacher rating (SSBD) • No exclusion criteria	Grade 1 – 3	• 2 years • Treatment arm: mainly BP and CB, but if necessary for individual children also social skills, academic tutoring or problem solving with parents • Control arm: waitlist group not receiving intervention during assessment period
6. Dolan et al., 1993: Good Behavior Game (GBG) or Mastery Learning (ML)			
Randomized to treatment or external control group at school level, matching on students' achievements, SES and ethnicity. Within intervention schools, classrooms and new students were randomly assigned to treatment or (internal) control group	• *N* = 394 193 boys; 201 girls • Community sample in 'at-risk' schools (low SES) • No exclusion criteria	Grade 1	• 1 year • 2 treatment arms: GBG group received BP (universal program) and ML group received enriched reading curriculum • Control arm: no treatment group. Internal and external control groups were used (control classrooms within intervention school, and separate control schools, respectively)
7. Fabiano et al., 2010: Daily Report Card			
Randomization at student level.	• *N* = 63 54 boys; 9 girls • Clinical ADHD based on parent interview (DBD) and on parent and teacher rating (DBD) • Exclusion criterion: IQ < 80	6 – 12 years Grade 1 - 6	• 8 months • Treatment arm: BP • Control arm: care as usual

Parameters used for effect size calculation and other relevant statistical information	Outcome measures and instruments used for effect size calculation	Study quality[a]
• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (6 months) • Baseline differences: SES: control > treatment • Special remarks: since *N* differed at pre- and post-assessment, the average *N* was used to calculate the study's effect size	Outcome measures: • DBP: BASC, externalizing scale (T) • ADHD: CRS (T) • ODD/CD: n.a. • On-task: n.a.	2
• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (6 months) • Baseline differences: - SES: control > treatment - Special education: control > treatment • Special remarks: data of graduates (successfully completing the program) and non-graduates (not having completed the program successfully) were averaged	Outcome measures: • DBP: TRF, externalizing scale (T) • ADHD: n.a. • ODD/CD: n.a. • On-task: SSBD, stage 3 (% of AET in 20 minutes)	2
• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (6 months) • Baseline differences: none • Special remarks: - Data of boys and girls were averaged - Data of GBG group and external control group were used, to enhance comparability with the other studies in this meta-analysis mostly using external control groups - Analyses did not account for severity of problem behavior	Outcome measures: • DBP: TOCA-R aggression scale (T) • ADHD: n.a. • ODD/CD: TOCA-R, aggression scale (T) • On-task: n.a.	1
• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (8 months) • Baseline differences: none • Special remarks: none	Outcome measures: • DBP: DBD (T) and observation (average frequency counts of classroom rule violations) • ADHD: DBD, ADHD scale (T) • ODD/CD: DBD, average of ODD and CD scale (T) • On-task: n.a.	3

Randomization level	Sample, inclusion and exclusion criteria	Age range / grade range at T_0	Intervention duration and elements of treatment and control arm
8. Flannery et al., 2003: Peacebuilders			
Randomized block design[b], with schools as blocks that were matched on geographic proximity, % of ethnic students, % of students receiving free lunch, and % of classrooms with English as a second language	• *N* = 4195 Gender ratio n.r. • Community sample • No exclusion criteria	Kindergarten – Grade 5	• 1 year • Treatment arm: BP and social-emotional skills (universal program) • Control arm: waitlist group not receiving intervention during assessment period
9. Iovannone et al., 2009: Prevent-Teach-Reinforce Tertiary Intervention			
Randomization at individual level, after being matched on age and language ability	• *N* = 245 200 boys; 45 girls • At risk for EBD based on teacher rating (SSBD), persistence > 6 months, and school absence < 1 time per week on average • Only 1 student per teacher could participate and student with most severe DBP was included	Kindergarten – Grade 8 (7% middle schoolers)	• 71 days • Treatment arm: BP, CB, social skills, curricular modifications, and peer tutoring • Control arm: care as usual
10. Leflot, Van Lier, Onghena, & Colpin, 2010: Good Behavior Game			
Randomization at classroom level (assigning one classroom within each school to the treatment group and a second classroom in the same school to the control group)	• *N* = 570 282 boys; 288 girls • Community sample • No exclusion criteria	Grade 2 – 3	• 2 years • Treatment arm: BP (universal program) • Control arm: no treatment
11. Miranda, Presentación, & Soriano, 2002			
Randomization at individual level	• *N* = 50 42 boys; 8 girls • Clinical ADHD based on teacher and parent rating (DSM-IV Rating Scale), symptoms present > 1 year, and onset ≤ 6 years • Exclusion criteria: special education, IQ < 80, use of medication and psychosis or gross neurological, sensory or motor impairment	Grade 3 – 4	• 4/5 months • Treatment arm: BP and CB. • Control arm: no treatment

Parameters used for effect size calculation and other relevant statistical information	Outcome measures and instruments used for effect size calculation	Study quality[a]
• Parameters: *t* and *N* for T_0 (baseline) and T_1 (6 months), controlling for pretest scores and gender • Baseline differences: n.r. • Special remarks: - Data were reported separately in this study for Kindergarten – Grade 2 and for Grade 3 – 5, and were averaged for this meta-analysis - For Grade 3 – 5, program effects were larger for children with more aggression. For Kindergarten – Grade 2, severity of aggression did not moderate program effects. - Excluded from meta-regression with gender as moderator since % of males was not reported	Outcome measures: • DBP: TRF, aggression scale (T) • ADHD: n.a. • ODD/CD: TRF, aggression scale (T) • On-task: n.a.	2
• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (10 weeks) • Baseline differences: race: treatment > control • Special remarks: SSRS-PB was not used as measure of DBP or ODD/CD since one third of these items focus on internalizing problems	Outcome measures: • DBP: n.a. • ADHD: n.a. • ODD/CD: n.a. • On-task: % of AET (during 2 x 15 minutes)	2
• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (9 months) • Baseline differences: none • Special remarks: - The exact number of students per group was not reported so authors were contacted in order to obtain this information - Analyses did not account for severity of problem behavior	Outcome measures: • DBP: Van der Sar's classroom observation (2004), average of talking and out of seat behavior • ADHD: n.a. • ODD/CD: n.a. • On-task: Van der Sar's classroom observation, on-task scale	1
• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (5 months) • Baseline differences: ADHD-score: treatment > control • Special remarks: none	Outcome measures: • DBP: CRS, average of ADHD and ODD/CD (T) • ADHD: CRS, ADHD scale (T) • ODD/CD: CRS, aggression scale (T) • On-task: n.r. (only pretest scores were available, so effect sizes could not be calculated)	2

Randomization level	Sample, inclusion and exclusion criteria	Age range / grade range at T_0	Intervention duration and elements of treatment and control arm
12. MTA Cooperative Group, 1999: Summer Treatment Program			
Randomization at individual level	• *N* = 260 208 boys; 52 girls • Clinical ADHD based on parent interview (DISC) and parent and teacher ratings • Exclusion criteria: IQ < 80, psychosis or other disorders (psychiatric or neurological) or illnesses requiring separate treatment, and medication intolerance	7 – 9.9 years Grade 1 – 4	• 14 months • 3 treatment arms: behavior group received BP, CB, social skills, and sport skills; medication group used methylphenidate, and combined group received behavior and medication treatment; multimodal: parent and child component • Control arm: care as usual
13. Östberg & Rydell, 2012: modified version of Barkley's program			
Randomization at individual level	• *N* = 92 77 boys; 15 girls • Mainly clinical ADHD: 93% were diagnosed by a psychiatrist, the remainder of the sample was in the process of being diagnosed • Exclusion criteria: mental retardation	7 – 10 years	• 10 weeks • Treatment arm: BP and CB; multimodal: also parent component • Control arm: waitlist control group with care as usual during assessment period
14. Owens, Murphy, Richerson, Girio, & Himawan, 2008			
Randomization at school level	• *N* = 117 90 boys; 27 girls • Mainly clinical EBD (85%), based on referral by teachers for externalizing problems • No exclusion criteria	Kindergarten – Grade 6	• 1 year • Treatment arm: BP; multimodal: also parent and child components • Control arm: waitlist group not receiving intervention during assessment period
15. Sumi et al., 2012: First Step to Success			
Randomization at school level	• *N* = 286 220 boys; 66 girls • At-risk for EBD based on teacher rating (SSBD) • No exclusion criteria	Grade 1 – 3	• 8 weeks • Treatment arm: BP, CB and peer tutoring; multimodal: also parent component • Control arm: waitlist group not receiving intervention during assessment period
16. Walker et al., 2009: First Step To Success Early Intervention			
Randomization at student level	• *N* = 200 102 boys; 98 girls • At-risk for EBD based on teacher rating (SSBD) • No exclusion criteria	Grade 1 – 3	• 8 weeks • Treatment arm: BP, CB and peer tutoring; multimodal: also parent component • Control arm: care as usual

	Parameters used for effect size calculation and other relevant statistical information	Outcome measures and instruments used for effect size calculation	Study quality[a]
	• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (14 months) • Baseline differences: age: control > treatment • Special remarks: - Since *N* differed at T_0 and T_1, the average *N* was used to calculate ES - Only data of behavioral treatment and comparison group were used in this meta-analysis	Outcome measures: • DBP: SNAP (T) and COC (observation), average HI and ODD scale • ADHD: SNAP (T), average HI and I scale • ODD/CD: SNAP (T), ODD scale • On-task: n.a.	3
	• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (10 weeks) • Baseline differences: none • Special remarks: none	Outcome measures: • DBP: average ADHD (ADHD Rating Scale) and ODD/CD (DSM-IV criteria) (T) • ADHD: ADHD Rating Scale (T) • ODD/CD: Rating based on eight DSM-IV criteria (T) • On-task: n.a.	2
	• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (6 months) • Baseline differences: - Age: treatment > control - ADHD at T_0: treatment > control • Special remarks: none	Outcome measures: • DBP: DBD Rating Scale, average ADHD and ODD/CD • ADHD: DBD Rating Scale, average HI and I scale (T) • ODD/CD: DBD Rating Scale, average ODD and CD scale (T) • On-task: n.a.	2
	• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (3 months) • Baseline differences: SSBI-MBI score at T_0:Treatment > control • Special remarks: SSRS-PB was not used as measure of DBP or ODD/CD since one third of these items focus on internalizing problems	Outcome measures: • DBP: SSBD-MBI (T) • ADHD: n.a. • ODD/CD: n.a. • On-task: % of AET (during 2 x 15 minutes)	2
	• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (3 months) • No baseline differences • Special remarks:SSRS-PB was not used as outcome measure since one third of the items focus on internalizing problems	Outcome measures: • DBP: SSBD-MBI (T) • ADHD: n.a. • ODD/CD: n.a. • On-task: % of AET (during 2 x 15 minutes)	3

Randomization level	Sample, inclusion and exclusion criteria	Age range / grade range at T_0	Intervention duration and elements of treatment and control arm
17. Waschbusch, Pelham, & Massetti, 2005: Behavior Education Support and Treatment			
Randomization at school level	• *N* = 64 Gender ratio n.r. • At-risk for EBD based on teacher ratings • No exclusion criteria	5 - 12 years Grade 1 – 6	• 1 year • 3 treatment arms: schoolwide (universal program for all students and individual program for non-responders), target school (only for children nominated by teacher), and target home. All involved BP, problem solving, and academic skills • Control arm: no treatment control group
18. Williams, Noell, Jones, & Gansle, 2012: Electronic Daily Behavior Report Card			
Randomization at individual level	• *N* = 46 37 boys; 9 girls • At-risk for EBD based on teachers' behavior concerns • Exclusion criteria: medication use, enrollment in special education program	Grade 1 – 5	• 3 weeks • 2 treatment arms: daily report card with and without feedback from teacher to parent. Both involved BP. • Control arm: waitlist group with no intervention during assessment period
19. Witvliet, van Lier, Cuijpers, & Koot, 2009: Good Behavior Game			
Randomization at classroom level	• *N* = 758 379 boys; 379 girls • Community sample • No exclusion criteria	Kindergarten – Grade 2	• 2 years • Treatment arm: BP (universal program) • Control arm: no treatment group

AET = Academic Engagement Time;
ADHD = Attention Deficit Hyperactivity Disorder;
ADS-IV = Assessment of Disruptive Symptoms – fourth version;
BASC = Behavioral Assessment System for Children;
BOSS = Behavioral Observation of Students in School;
BP = Behavioral Program;
CB= Cognitive-Behavioral elements in intervention;
COC = Classroom Observation Code;
CRS = Conners' Rating Scale;
CRS-R = Conners' Rating Scale – Revised;
EBD = Externalizing Behavior Disorders (ADHD, ODD, and/or CD);
DISC = Diagnostic Interview Schedule for Children;
DSM = Diagnostic and Statistical Manual of Mental disorders;
DBP = Disruptive Behavior Problem;
EBD = Emotional and Behavioral Disorder;
GBG = Good Behavior Game;
HI = Hyperactivity/Impulsivity scale;
I = Inattention scale;
IEP = Individualized Education Program;
IQ = Intellectual Quotient;
ML = treatment program Mastery Learning;
n.a. = not assessed;
n.r. = not reported;
ODD/CD = Oppositional-Defiant Disorder or Conduct Disorder;
P = Parent version;
PBSI = Problem Behavior at School Interview;

Parameters used for effect size calculation and other relevant statistical information	Outcome measures and instruments used for effect size calculation	Study quality[a]
Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (approximately 8 months) • Baseline differences: Age: control > treatment • Special remarks: - Data of the 'Target School'-group was used as treatment group - Since *N* differed at T_0 and T_1, the average *N* was calculated	Outcome measures: • DBP: ADS-IV, average ADHD and ODD (T), • ADHD: ADS-IV, average HI and I scale (T) • ODD/CD: ADS-IV, ODD-scale (T) • On-task: n.a.	2
• Parameters: *M, SD* and *N* for T_0 (baseline) and T_1 (3 weeks) • No baseline differences • Special remarks: data of the two treatment arms were averaged and treated as one treatment group	Outcome measures: • DBP: TRF, externalizing scale (T) and classroom observation (3 x 15 minutes) • ADHD: CRS-R, ADHD-scale (T) • ODD/CD: n.a. • On-task: n.a.	1
• Parameters: *M, SD* and *N* for T_2 and T_3 (9 months) • Baseline differences: - SES: control < treatment - Race: less Dutch/Caucasian children in control group • Special remarks: - T_2 and T_3 were used since extra students were included between T_0 and T_1, who differed on nationality and SES from the sample at T_0. Therefore, the baseline and follow-up assessment from the second year were used (T_2 and T_3) - Data of male and female were averaged - Analyses did not account for severity of problem behavior	Outcome measures: • DBP: PBSI (T), externalizing scale consisting of an ODD and CD scale • ADHD: n.a. • ODD/CD: PBSI (T), externalizing scale • On-task: n.a.	2

RCT = Randomized Controlled Trial;
SES = Socioeconomic Status of the child's family;
SNAP = Swanson, Nolan and Pelham Questionnaire;
SSBD = Systematic Screening for Behavior Disorders;
SSBD-MBI = Systematic Screening for Behavior Disorders - Maladaptive Behavior Index;
SSRS-PB = Social Skills Rating System - Problem Behavior;
T = Teacher version;
T_0 = first assessment (baseline);
T_1 = second assessment;
T_2 = third assessment (begin 2nd school year);
T_3 = fourth assessment (end 2nd school year);
TOCA-C = Teacher Observation of Classroom Adaptation – Checklist;
TOCA-R = Teacher Observation of Classroom Adaptation – Revised;
TRF = Teacher Report Form.

[a] Study quality was assessed based on Jadad's criteria (Jadad, et al., 1996)
[b] Randomized block design = design in which 2 schools (or in one study 2 school districts) formed a block. Within each block, one school (or school district) was randomly assigned to the treatment arm while the other school was assigned to the control arm. For each study using this design, it is mentioned whether a block referred to schools or school districts, and which criteria schools or school districts were matched on.

Post-hoc analyses were used to investigate whether treatment response depended on type of problem behavior (symptoms of ADHD or ODD/CD) or on type of sample (clinical, at-risk, and community). In clinical samples, all participants or a large majority thereof (≥85%) met diagnostic criteria for one or more externalizing behavior disorders. At-risk samples consisted of participants with elevated levels of disruptive behavior problems at school as assessed in each study. In community samples, non-selective samples were studied including entire classrooms or entire schools.

Gender was defined as percentage of male participants in the study sample. Age was defined as the average age (in years) of the study sample at baseline. If age was not reported (in 8 of the 19 studies), an estimation of age was made based on participants' grade levels (assuming 6.5 years as the average age in grade 1, 7.5 years in grade 2, etcetera; Eurydice, 2015), taking into account the percentage of children in each grade. If the percentage of children in each grade was not reported, an equal distribution of children across grades was assumed. Intervention duration was defined in months. Some intervention programs had a duration of more than one year and incorporated multiple post-intervention outcome measurements. For those studies, only the first two measurements were used to maximize homogeneity in intervention duration across studies in the meta-analysis.

Study Quality

The quality of the studies was assessed by two independent researchers (BV and ML) using the Jadad criteria (Jadad et al., 1996) that includes three items of study quality (randomization, double blinding, and withdrawals and dropouts). Each study was scored on a 6-point scale (0-5), with scores of 2 or less indicating low study quality, and scores of 3 or more points indicating high quality. For all studies, consensus was reached between the researchers.

Statistical Analyses

Statistical analyses were performed using Comprehensive Meta-Analysis (Borenstein, Hedges, Higgins, & Rothstein, 2005). Effect sizes (Cohen's *d*) were calculated for the effects of the behavioral program within each study for each dependent variable by using the mean, *SD* and sample size of both groups (intervention and control) at baseline and at follow-up assessment. The pooled *SD* was weighted by its inverse variance to control for sample size and measurement error (Borenstein et al., 2011). To maximize homogeneity, we used the reported means and *SD*s without any covariates when available.

If mean, *SD*, or sample size information was not available, the *t*-value of the effect of the intervention on the dependent variable was calculated by dividing the regression beta coefficient of the group x time interaction by its standard error (Field, 2009), or the Fisher's *z* score was calculated using the correlation-value of each dependent variable together with the sample size, which were then converted into Cohen's *d* (Borenstein et al., 2011). For studies reporting results for subgroups (e.g. for males and females separately), the weighted group mean was calculated by multiplying each subgroup mean by its sample size, and then adding the subtotals and dividing the obtained sum by the total sample size (Borenstein et al., 2011).

Main Analyses

First, we investigated meta-analytic effects of behavioral classroom programs on (1) disruptive behavior, distinguishing between teacher-ratings and classroom observations, and on (2) on-task behavior as measured by classroom observations. To test whether the meta-analytic results on these outcome measures were confounded by baseline behavior differences between groups, sensitivity analyses were conducted excluding those studies reporting behavior differences at baseline (the existence of baseline differences are noted in Table 1).

In case of significant intervention effects on teacher-rated disruptive behavior, two additional analyses were performed to ascertain that positive effects were due to behavioral classroom programs rather than interventions in other settings (e.g. parent or child training) or program components other than behavioral techniques (e.g. cognitive behavioral components). One meta-analysis was performed on intervention studies that only involved behavioral components, thus excluding studies into programs that also comprised other treatment components (see Table 1). Another separate meta-analysis tested the specific effect of programs in the classroom setting, by including only studies that were confined to a unimodal teacher program (see Table 1). These two meta-analyses were only conducted on teacher-rated disruptive behavior due to the limited number of studies using classroom observations.

Post-Hoc Analyses

In case of significant intervention effects, several post-hoc analyses were performed to investigate for whom and under which conditions behavioral classroom programs would be most effective. These analyses were only performed on teacher-rated disruptive behavior, as the number of available studies was too limited to carry out these analyses for the other outcome

measures. Firstly, program effects were assessed separately for symptoms of ADHD and for ODD/CD to investigate whether effects depended on type of problem behavior. Secondly, the potential moderating effect of severity of problem behavior was investigated by comparing the type of samples (clinical, at-risk and community samples) through a Q-between test, using the nature of the sample as a nominal variable (Borenstein et al., 2011). This analysis investigated whether the efficacy of behavioral programs differed between clinical, at-risk, and community samples. Thirdly, meta-regression analyses were performed to test whether gender (% of male students), age and intervention duration moderated the effects on the outcome measures. There were no missing data on any of the variables, except for one study not reporting the sample's gender distribution (Flannery et al., 2003). This study was excluded from the meta-regression analyses on gender.

Given the heterogeneity between trials (e.g. due to differences between the behavioral programs and outcome measures), the random-effects model for heterogeneously distributed data was used to calculate meta-analytic effect sizes (Borenstein et al., 2011). Q and I_2 tests were used to test the assumption that the data were heterogeneously distributed. The threshold for performing a meta-analysis was set at the frequently-used limit of three studies (Dalton, Daily, Certo, & Roengpitya, 2003; De Kieviet, Zoetebier, Van Elburg, Vermeulen, & Oosterlaan, 2012). Effect sizes were interpreted applying Cohen's guidelines, translating d = 0.20, 0.50, and 0.80 into thresholds for small, medium, and large effects, respectively (Cohen, 2013). Negative effect sizes indicated that behavioral programs effectively reduced the problem behavior compared to no care or care as usual.

For all meta-analyses, the possibility of publication bias was assessed through Rosenthal's fail-safe N to determine the number of studies necessary to nullify the overall effect and linear regression methods to examine the degree of funnel plot asymmetry (Egger, Smith, Schneider, & Minder, 1997; Rosenthal, 1995). To investigate whether effect sizes were moderated by study quality, a meta-regression tested the effect of study quality on the effect sizes obtained for the individual studies. This meta-regression was only performed for teacher-rated disruptive behavior since less than ten studies were available for the other outcome measures, which is required as minimum for adequate meta-regressions (Borenstein et al., 2011). Significance testing was two-sided and α was set at .05.

RESULTS

A total of 18,074 children from 19 different studies were included in this meta-analysis. Study characteristics are displayed in Table 1. Seven studies involved children with clinical levels of disruptive behavior (ADHD, ODD or CD), seven studies included children at-risk for externalizing behavior disorders, and five studies involved community samples. In the community samples, on average 50% was male (*SD* = 0.58; range 49-53), whereas in studies using clinical or at-risk samples, percentages of male subjects were on average 75% (*SD* = 11.84; range 51-84). While all studies predominantly involved primary school children, seven studies also included children from kindergarten and one study included children from middle school. All studies used behavioral programs as main element of their program, but some studies additionally included cognitive behavioral elements (*n* = 9), social skills training (*n* = 5), peer tutoring (*n* = 5), academic assistance (*n* = 2), problem solving training (*n* = 2), or sport skills training (*n* = 1). Eleven programs were multimodal, of which seven involved a parent training, one involved a child training, and three involved both a parent and child training.

Table 2 provides an overview of all meta-analytic results and heterogeneity statistics. First, the results of the main analyses on disruptive behavior and on-task behavior will be discussed. Thereafter, the post-hoc results will address whether program effects depended on type of problem behavior, type of sample (severity of problem behavior), or on gender, age or intervention duration.

Main Analyses

Effects of Behavioral Classroom Programs on Disruptive Behavior

A total of 17 studies investigated the efficacy of behavioral programs in reducing disruptive behavior through teacher-ratings and three studies used classroom observations by an independent rater as the dependent measure. Results are shown in Figure 2. The meta-analytic results showed that behavioral classroom programs had significant beneficial effects on teacher-rated disruptive behavior with a small effect size (d = -0.20, $p < .001$), indicating that behavioral classroom programs resulted in larger reductions of disruptive behavior compared to no treatment or treatment as usual. The sensitivity analysis on studies without significant group differences in baseline level of problem behavior revealed a similar significant effect that was somewhat smaller (14 studies, d = -0.15, p = .001). For classroom observations, no significant beneficial effect was found on disruptive behavior (4 studies, d = 0.48, p = .13).

	Meta-analytic effect size						Homogeneity			Publication bias	
	N	# of studies	*d*	lCI	uCI	*p*	*Q*	I_2	*p*	*p* Egger funnel plot	Fs *N*
Teacher-rated DBP	18,074	17	-0.20	-0.29	-0.10	<0.001	47.36	66.21	<0.001	0.01	176
Observed DBP	907	4	-0.48	-1.11	0.15	0.13	43.33	93.08	<0.001	0.32	13
Observed on-task	1,658	6	0.39	0.21	0.57	<0.001	15.86	68.47	<0.01	0.24	87
ADHD (Teacher)	13,313	9	-0.19	-0.35	-0.02	0.02	19.92	59.84	0.01	0.03	27
ODD/CD (Teacher)	16,743	10	-0.15	-0.23	-0.06	<0.01	16.91	46.78	0.05	0.01	51
Sample											
Community	16,138	5	-0.15	-0.30	-0.01	0.04	11.50	73.91	0.01	0.01	22
At-risk	1,081	6	-0.26	-0.42	-0.09	<0.01	18.58	73.00	<0.01	0.36	19
Clinical	828	7	-0.19	-0.35	-0.04	0.01	6.78	11.47	0.34	0.11	9

Note. Negative effect sizes indicate a reduction of disruptive behavior in the treatment condition compared to the control condition. ADHD = symptoms of Attention Deficit Hyperactivity Disorder; ODD/CD = symptoms of Oppositional Defiant Disorder and/or Conduct Disorder; DBP = Disruptive Behavior Problems; Fs N = fail-safe *N*.

Table 2. Overview meta-analytic results of classroom-based behavioral programs on disruptive behavior

The additional meta-analysis on intervention studies that only involved behavioral management (without other intervention components such as social skills training or peer tutoring) yielded a significant small effect (6 studies, $d = -0.24$, $p = .01$). The separate meta-analysis on the studies that were confined to classroom programs without interventions in other settings (e.g. parent programs), also revealed a significant effect (6 studies, $d = -0.16$, $p < .01$). These meta-analytic findings confirm the robustness of the positive effects of behavioral classroom programs on teacher-rated disruptive behavior.

For teacher-rated disruptive behavior, indications of a publication bias were found based on Egger's regression ($p = .01$), but this bias seemed unlikely based on Rosenthal's fail-safe *N* statistic which showed that 176 studies were necessary to bring the *p*-value above the alpha-level of .05. There was no evidence of publication bias for classroom-observed disruptive behavior, ($p = .32$ based on Egger's regression and Rosenthal's fail-safe $N = 13$). Between-study heterogeneity was significant in the meta-analyses on teacher-rated and classroom-observed disruptive behavior, supporting the use of random effects meta-analyses. Study quality was not significantly associated with the studies' effect sizes for teacher-rated disruptive behavior ($\beta = 0.01$, $p = .88$).

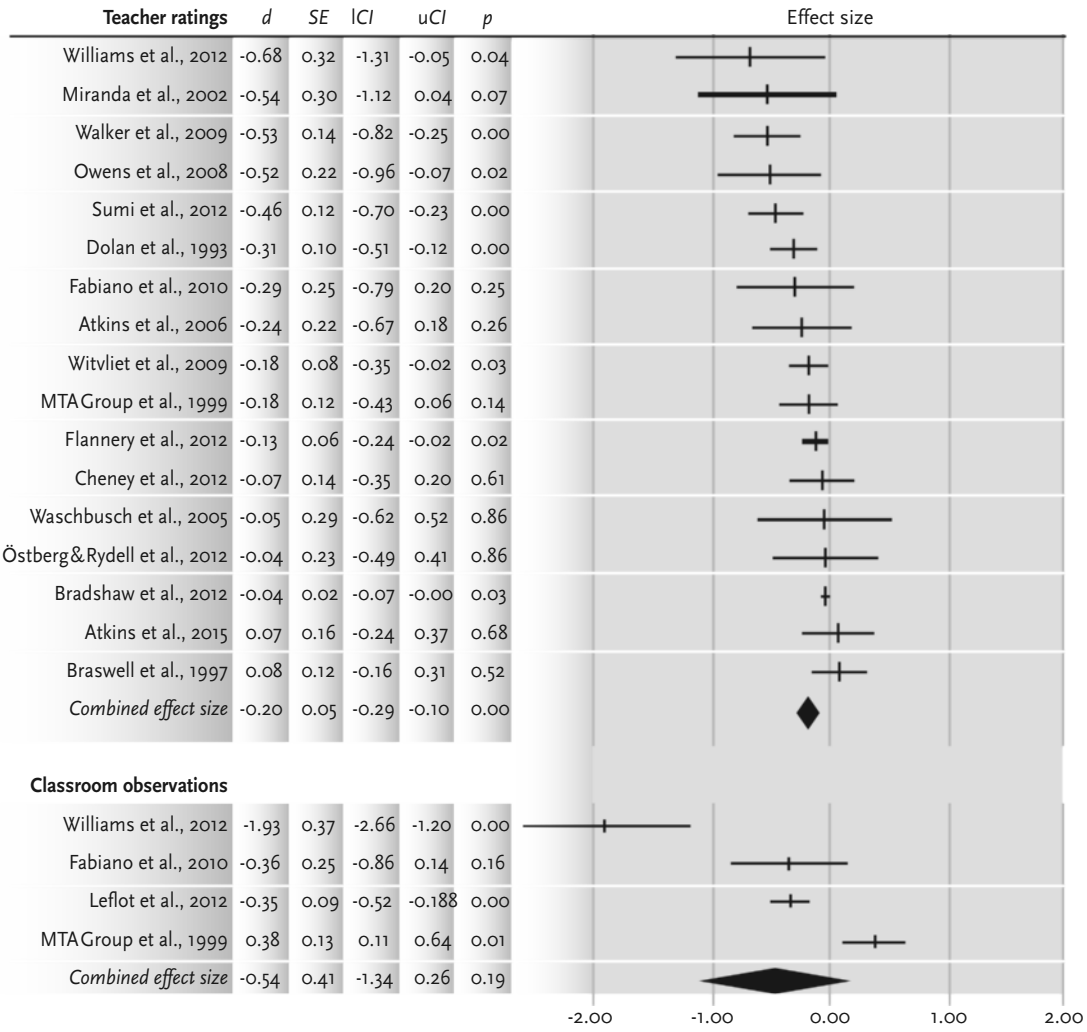

Figure 2. Effect sizes of individual studies and combined effect sizes on disruptive behavior problems. Meta-analytic results reveal a significant reduction of teacher-rated disruptive behavior in response to behavioral classroom programs.

Effect of Behavioral Classroom Programs on On-Task Behavior

Meta-analytic results of six studies using classroom observations to assess on-task behavior, reported a significant, small beneficial effect ($d = 0.39$, $p < .001$). A sensitivity analysis on four of these studies that showed no baseline group differences revealed identical findings ($d = 0.36$, $p = .01$). There was no evidence of publication bias ($p = .24$ based on Egger's regression and Rosenthal's fail-safe $N = 87$). Between-study heterogeneity was significant.

Post-Hoc Analyses

Additional analyses were conducted on teacher-rated disruptive behavior to investigate which children would benefit most from behavioral classroom programs, and under which circumstances.

Program Effects on Teacher-Rated ADHD and ODD/CD Symptoms

There were nine studies investigating the effects of behavioral programs on teacher-rated ADHD and nine studies assessing the effects on teacher-rated ODD/CD symptoms. Behavioral programs had significant but small beneficial effects on teacher-rated ADHD symptoms (d = -0.19, p = .02) and teacher-rated ODD/CD symptoms (d = -0.15, p < .01). No indications for publication bias were found for the meta-analytic effect sizes for teacher-rated symptoms of ADHD and ODD/CD based on Rosenthal's fail-safe N (27 and 51 studies, respectively), but Egger's regression did suggest an asymmetric funnel plot for both outcome measures (p = .03 and p = .01, respectively). Between-study heterogeneity was significant for teacher-rated ADHD, and close to significant for teacher-rated ODD/CD (p = .05).

Comparison between Clinical, At-Risk and Community Samples

Meta-analytic results on teacher-rated disruptive behavior were calculated for clinical, at-risk and community samples to investigate whether treatment response was stronger for children with higher levels of disruptive behavior compared to children with less disruptive behavior. Meta-analytic results revealed significant small effects on disruptive behavior in all three samples, although effects were somewhat larger for at risk samples (6 studies, d = -0.26, p < .01), than for clinical and community samples (7 studies, d = -0.19, p = .01 and 4 studies, d = -0.15, p = .04, respectively). The between-group comparison was not significant though ($Q(2)$ = 0.95, p = .62). There was no evidence of publication bias for at-risk (Egger's p = .36 and Rosenthal's fail-safe N = 19) and clinical samples (Egger's p = .11 and Rosenthal's fail-safe N = 9). For community samples, some evidence of a publication bias was found based on Egger's regression (p = .01), but not based on the Rosenthal's fail-safe N statistic (22 studies). Between-study heterogeneity was significant for the community and at-risk sample, but not for the clinical sample.

Moderating Effects of Intervention Duration, Age and Gender

Meta-regression analyses revealed a negative trend between intervention duration and effect sizes for teacher-rated disruptive behavior ($b(SE)$ = 0.006(0.003), p = .06, R^2 = .22), suggesting larger effects for behavioral

programs with a shorter duration. To assess the possibility that this trend was driven by one study (Bradshaw, Waasdorp, & Leaf, 2012) with a much larger intervention duration (48 months) than the other studies (ranging between 0.8-14 months), the association between effect size and intervention duration was also investigated without that study, now yielding a stronger and significant effect (*b(SE)* = -0.03(0.01), $p = .02$, $R^2 = .43$) in the same direction (see Figure 3). Age (ranging between 6-11 years) did not moderate the teacher-rated effect of behavioral programs on disruptive behavior (*b(SE)* = -0.005(0.05), $p = .91$). Furthermore, gender (ranging between 49-86% males) did not moderate the teacher-rated effect on disruptive behavior (*b(SE)* = 0.19(0.40), $p = .64$), and similar non-significant effects were found when power was increased by inserting the data for boys and girls separately for two studies reporting gender-specific effect sizes (Dolan et al., 1993; Witvliet et al., 2009).

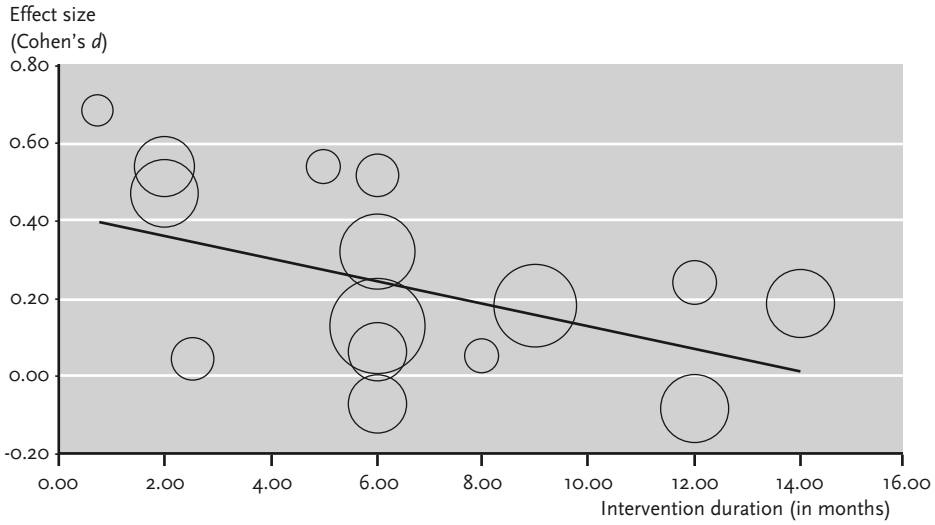

Figure 3. Meta-regression on 15 studies revealing a significant negative association between the studies' effect sizes and intervention duration ($B = 0.03$, $p = .02$, $R^2 = .43$).

DISCUSSION

This is the first meta-analysis of RCTs into the efficacy of behavioral classroom programs on elementary school disruptive behavior problems (19 RCT's, N = 18,074 participants). Results confirm our hypothesis that behavioral programs effectively reduce teacher-rated disruptive behavior and improve classroom-observed on-task behavior, albeit with small effects. The effect on classroom-observed disruptive behavior was not significant, but more studies are necessary

to confirm these findings given the limited number of studies contributing to this analysis ($n = 4$). Post-hoc results indicated that behavioral classroom programs had similar positive effects on both teacher-rated ADHD symptoms and teacher-rated ODD/CD symptoms. Furthermore, results suggested that program effects were similar for a wide group of children, irrespective of severity of problem behavior, gender, and age. However, programs of a shorter duration were more effective than lengthier programs.

The positive effects that we found for behavioral classroom programs on teacher-rated disruptive behavior are in line with previous reviews and meta-analyses (Gaastra et al., 2016; Maggin, et al., 2012; Stage & Quiroz, 1997; Wilson & Lipsey, 2007). Those earlier reviews and meta-analyses, however, predominantly included single- or within-subject designs. Our meta-analytic effect sizes are smaller than the effect sizes found in reviews that also included single-subject or within-subject designs (Gaastra et al., 2016; Maggin et al., 2012; Stage & Quiroz, 1997). These smaller meta-analytic effect sizes may be explained by our exclusive focus on RCTs in which the risk of bias, and thus of inflated effect sizes, is minimized compared to single-subject or within-subject designs (Jüni et al., 2001; Kantowitz et al., 2014; Kazdin, 2003; Pelham & Fabiano, 2008). These differences in effect sizes also highlight the importance of RCTs in efficacy trials.

Independent raters not involved in treatment delivery (i.e., less-proximate raters) observed positive effects of behavioral classroom programs. Although these raters did not report positive effects for disruptive behavior, they did report an improvement of on-task behavior. This result implies that children are able to pay more attention to their school work after participating in behavioral classroom programs. Our findings are in line with a recent meta-analysis (Daley et al, 2014) demonstrating that beneficial effects of behavioral parent interventions (targeting ADHD) can be captured by less-proximate instruments such as behavioral observations. According to the investment argument, teachers involved in treatment delivery may be biased, which could result in inflated effect sizes. Possibly, the lack of an effect on classroom-observed disruptive behavior in the current study, can be explained by the investment argument. However, the present meta-analysis was restricted to three studies and awaits replication with a larger number of studies. We strongly recommend future randomized efficacy trials to use classroom observations as outcome besides most proximate measures such as teacher-ratings, in order to provide a comprehensive view on the efficacy of behavioral programs.

Our results also reveal that behavioral classroom programs were equally effective for clinical, at-risk and community samples, indicating that program effects did not depend on severity of problem behavior. This contrasts with our expectations, because superior program effects were hypothesized for children with clinical levels of disruptive behavior as there would be more room for improvement in these children (Lundahl et al., 2006). Although our results are in line with a meta-analysis where effects of Individualized Positive Behavior Support at school were similar for diagnosed and undiagnosed children (Goh & Bambara, 2010), other meta-analytic evidence suggests worse effects of psychosocial parent trainings for children with more severe behavior problems (Reyno & McGrath, 2006). Despite the inconsistent meta-analytic literature regarding the influence of problem severity on treatment effects of psychosocial interventions in general, the hopeful results of this meta-analysis suggest that also children with clinical levels of disruptive behavior problems may benefit from behavioral classroom programs.

The absence of a moderating effect of gender was unexpected (Comer et al., 2013), because, in general, boys display higher levels of disruptive behavior (Gershon & Gershon, 2002; Maughan, Rowe, Messer, Goodman, & Meltzer, 2004; Moffitt, Caspi, Harrington, & Milne, 2002) and severity of problem behavior has been associated with higher responsiveness to parent behavior programs due to more room for improvement (Lundahl et al., 2006). Some caution is warranted when interpreting the results of our meta-regressions though, because these analyses can only assess the relationship between the moderator and treatment efficacy *across* trials, and thus are unable to take into account the variability of participant characteristics *within* each study (Thompson & Higgins, 2002). Individual studies included in the meta-regressions, for example, did reveal a higher treatment response for boys compared to girls (Dolan et al., 1993; Witvliet et al., 2009) and for older compared to younger children (Flannery et al., 2003; J. S. Owens, Murphy, Richerson, Girio, & Himawan, 2008). Further, disruptive behavior is less prevalent in girls and effects of interventions are less investigated in girls, making it difficult to draw conclusions on the efficacy of behavioral classroom programs for girls. Since most studies fail to assess moderating effects of gender and age, meta-regressions are necessary to study these moderating effects despite their limitations. Fortunately, variability in age and gender was rather large in our meta-regressions (6.0 - 10.9 years and 49 - 84 % of male), contributing to the validity of our analyses.

Against our hypothesis, our meta-regression results indicate that behavioral programs with a shorter duration are more effective than more lengthy programs. The unexpected negative association between program duration and effect size might be related to implementation fidelity. Possibly, it was more difficult for teachers to effectively implement more lengthy programs since program implementation often degrades over time and implementation fidelity affects responsiveness to an intervention (Durlak & DuPre, 2008; Han & Weiss, 2005). Unfortunately, we were unable to assess this hypothesis as almost half of the studies did not report implementation fidelity and the others used many diverse ways to assess implementation fidelity (e.g. teacher reports versus observations, number of elements implemented, quality of implementation, number of days elements were implemented). Future studies should investigate the teachers' implementation fidelity and assess the development of problem behavior over the course of the program to investigate whether implementation fidelity can explain the negative association between program duration and effect size.

Several clinical implications of our results need to be mentioned. First, our results suggest that behavioral classroom programs effectively reduce symptoms of ADHD and ODD/CD for a wide range of children differing in age, gender, and sample. These findings suggest that behavioral classroom programs may be used as universal programs for the entire classroom, so that many children will be able to benefit from these programs at the same time. This approach has an advantage over selective programs targeting individual students, which will, in general, be relatively more time-consuming and thus more expensive. Second, the beneficial program effects found in the current meta-analysis were all small, indicating that other types of treatments (e.g. medication) might be needed to normalize problem behavior of these children in the classroom.

Some limitations must be taken into account. First, there was heterogeneity between studies as a result of differences between behavioral programs, sample characteristics, as well as type of instruments. However, our results were bolstered by several additional analyses (on studies exclusively focusing on behavioral programs and on studies restricted to unimodal teacher programs) and meta-regression analyses showed that the effects on teacher-rated disruptive behavior were unrelated to age, gender, type of problem behavior or clinical status, highlighting the robustness of our findings. Second, the aggregation of measures of ODD and CD into one outcome measure could be disputed due to, for example, gender- and age-specific differences between these two disorders (Maughan et al., 2004). Separating these disorders was not

feasible though, because we focused on symptoms (of ODD and CD) rather than diagnoses due to the inclusion of community and at-risk samples. Since ODD and CD show a substantial overlap in phenotypical manifestation, separating ODD symptoms from CD symptoms would have been practically impossible (American Psychiatric Association, 2013). Third, the meta-regression analyses on the moderators age, gender and intervention duration, were only performed on teacher-rated disruptive behavior due to the limited number of studies using parent-ratings or classroom observations. Since many studies included in the meta-regressions involved multimodal programs (e.g. additional parent program) or different components of interventions (e.g. cognitive behavioral elements), findings of the meta-regression might not be specific to behavioral classroom programs. Therefore, future randomized efficacy trials of unimodal behavioral teacher program are necessary to confirm whether these programs are indeed equally effective for a wide group of primary school children.

Conclusion

Our meta-analysis of 19 RCT studies, including 18,047 elementary school children, showed that behavioral classroom programs result in small but significant improvements of teacher-rated disruptive behavior and classroom-observed on-task behavior at school. Results further suggest that the effects on disruptive behavior are unrelated to age, gender, type of problem behavior (ADHD versus ODD/CD) or clinical status, but that shorter programs are more effective than more lengthy programs. Since the effects of these programs are small, other types of treatments (e.g. medication, or combined psychosocial interventions) or enhancement of treatment fidelity might be needed for normalization of disruptive classroom behavior. Nonetheless, our findings confirm that behavioral classroom programs can contribute to a reduction of disruptive classroom behavior for a large group of children, thus helping to prevent escalation of problem behavior in the classroom.

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Supplement 1. Search terms used in the database Pubmed

((((((((((((((((((externalizing problem*[tiab])) OR (externalizing behavi*[tiab])) OR (attention deficit disorder*[tiab])) OR (oppositional defiant disorder*[tiab])) OR ("Attention Deficit and Disruptive Behavior Disorders"[Mesh])) OR (disruptive behavi*[tiab])) OR (aggression*[tiab])) OR (Aggression[Mesh])) OR (conduct disorder*[tiab])) OR ("Conduct Disorder"[Mesh])) OR (attention deficit hyperactivity disorder*[tiab])) OR (adhd[tiab])) OR (Attention Deficit Disorder with Hyperactivity[Mesh])))

AND ((((((((((classroom-based intervention*[tiab])) OR ("Faculty"[Mesh] OR "Schools"[Mesh] OR "Teaching"[Mesh])) OR (primary school*[tiab])) OR (training techni*[tiab])) OR (educational techni*[tiab])) OR (teaching method[tiab] OR teaching methods[tiab])) OR (school*[tiab])) OR (faculties[tiab] OR faculty[tiab])) OR (teaching[tiab] OR teacher[tiab]))))

AND (Child[mh] OR Adolescent[mh] OR pediatrics[mh] OR minors*[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR girl*[tiab] OR kid[tiab] OR kids[tiab] OR child*[tiab] OR adolescen*[tiab] OR juvenil*[tiab] OR youth*[tiab] OR teen*[tiab] OR underage*[tiab] OR under age*[tiab] OR pubescen*[tiab] OR pediatric*[tiab] OR paediatric*[tiab] OR school*[tiab]))) AND

Therapy/Narrow[filter]

CHAPTER 3 A Randomized Effectiveness Trial of a Behavioral Teacher Program Targeting ADHD Symptoms

ABSTRACT

Objective

This study investigated the effectiveness of the Positivity & Rules Program (PR program), a behavioral teacher program targeting ADHD symptoms in the classroom involving both a student-focused and classroom-focused program.

Methods

Primary school children with ADHD symptoms ($N = 114$) were randomly assigned to the PR program ($n = 58$) or control group ($n = 56$). Teacher and parent ratings were used to assess behavioral, social and emotional functioning at baseline, during and after the intervention. Intervention effects were assessed using intention-to-treat multilevel analyses.

Results

Teachers reported positive effects on ADHD symptoms and social skills ($0.01 < f^2 > 0.36$). Effects did not generalize to the home setting.

Conclusion

The PR program holds promise for improving classroom behavior in children with ADHD symptoms and might prevent escalation of problem behavior.

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INTRODUCTION

Attention-Deficit Hyperactivity Disorder (ADHD) is one of the most common childhood psychiatric disorders, affecting 5% of all children (Polanczyk et al., 2007), and is characterized by excessive inattention and/or hyperactivity/impulsivity (American Psychiatric Association, 2013). Children with ADHD often experience behavioral and social problems at home and at school, and comorbid disorders including oppositional defiant disorder (ODD), conduct disorder (CD), and anxiety disorders (Daley & Birchwood, 2010; Hong et al., 2014). They also show an increased risk for adverse life events such as occupational and relational problems, substance abuse, and delinquency (Molina et al., 2007; Shaw et al., 2012). In addition, more than 10% of school-aged children display ADHD symptoms without meeting full diagnostic criteria, while experiencing similar problems and increased risks compared to children diagnosed with ADHD (Faraone et al., 2007; Hong et al., 2014). At school, academic problems of children with ADHD symptoms (e.g. poor reading and numeracy skills) often coincide with behavioral problems such as off-task behavior, disturbing behavior (e.g. not awaiting turns), and teacher disobedience, especially in case of comorbid conduct problems (Daley & Birchwood, 2010; Diamantopoulou et al., 2007; Wilens et al., 2002). Social problems, such as having few friends and difficulties sustaining friendships, are also common in children with ADHD symptoms, irrespective of meeting full diagnostic criteria (Hong et al., 2014; Hoza, 2007). Through recurrent negative feedback from teacher or peers, increasing emphasis on the child's negative behavior is likely to occur, further propelling the child's problem behavior (Hoza, 2007). Cleary, early identification and treatment of ADHD symptoms is essential to reduce the risk of problem behavior escalation (Kutcher et al., 2004). In this study, the effectiveness of a classroom-based behavioral program targeting children with ADHD symptoms is investigated.

Psychostimulant medication is currently used as first-line treatment of ADHD and has been shown to powerfully reduce ADHD core symptoms while also improving oppositional behavior, aggression and social interactions (Kutcher et al., 2004). Adverse side effects (i.e., headache, sleeping problems, and loss of appetite) are common though, and 20-30% of children do not respond favorably to simulants (Kutcher et al., 2004; MTA Cooperative Group, 1999). Furthermore, long-term effects of stimulants have not yet been established (J. Parker, et al., 2013; Van der Oord, et al., 2008b). Behavioral interventions, heavily relying on principles of contingency management, are found to enhance ADHD symptoms, conduct problems, and social skills in children displaying ADHD symptoms,

including both children with and without a diagnosis of ADHD (Charach et al., 2013; Daley et al., 2014; Fabiano et al., 2009; Wilson & Lipsey, 2007). Indeed, behavioral interventions are advised as first-line treatment for children with mild to moderate ADHD (Atkinson & Hollis, 2010). Therefore, behavioral teacher programs appear most suitable to address the problems that children with ADHD symptoms encounter at school.

Several studies have found that behavioral teacher programs effectively reduce classroom problem behavior including ADHD symptoms, oppositional behavior and conduct problems (Bradshaw, Mitchell, & Leaf, 2010; Evans et al., 2014; Miranda et al., 2002; Pelham & Fabiano, 2008; Pelham et al., 2000; Webster & Stratton, Jamila Reid, & Stoolmiller, 2008). Many of these programs, however, involve intensive and time-consuming training of teachers, which could compromise long-term sustainability as funding is often not available for such programs after research is terminated. The Positivity & Rules Program (PR program), a behavioral teacher program targeting ADHD symptoms, relies on a manual not requiring any additional teacher training and could possibly benefit many children while being sustainable at little cost (Durlak & Dupre, 2008). This program is based on common behavioral and classroom management strategies that are part of most behavioral classroom programs, which have proven to be effective as stand-alone program (see, for example, the review of Pelham & Fabiano, 2008). Low-cost programs such as the PR program are particularly important for children not meeting full diagnostic ADHD criteria, whose treatments are often not covered by private or public insurance.

The current randomized controlled trial tested the efficacy of the PR program on ADHD symptoms, conduct problems, social and emotional functioning compared to no treatment or care as usual. Effects of treatment were measured using teacher and parent ratings assessed before, during, and after the intervention. If proven effective, this behavioral teacher program might be used at large scale to address behavior problems in children displaying ADHD symptoms in the classroom.

METHODS

Participants

Participants were 114 children between 6 and 13 years of age attending regular primary school and displaying elevated levels of ADHD symptoms in the classroom. A total of 58 children (from 44 classrooms of 30 schools; 91% male) were randomly allocated to the PR program (intervention group) and 56 children

(from 43 classrooms of 34 schools; 77% male) were allocated to the control group. Teachers of children in the control group did not use the PR program, but these children were allowed to receive care as usual (22% eventually received some form of care, such as advice from a school counselor or parent training). Randomization occurred at school level to prevent information drift from teachers using the PR program to teachers of children in the control group.

Inclusion criteria were (a) elevated levels of ADHD symptoms (> 90th percentile) as reported by the child's teacher on the Hyperactivity/Impulsivity and/or Inattention scale of the Disruptive Behavior Disorders Rating Scale (DBDRS; Oosterlaan et al., 2008; Pelham, Gnagy, Greenslade, & Milich, 1992); and (b) at least three clinical and three subthreshold ADHD symptoms as assessed by Teacher Telephone Interview (TTI; Holmes et al., 2004), a semi-structured interview based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 2000). Exclusion criteria were (a) treatment for ADHD (including medication) at study entry or in the preceding 6 months; (b) a neurological or severe physical condition interfering with daily functioning; (c) IQ < 80 estimated using a short version of the third edition of the Wechsler Intelligence Scale for Children (WISC-III, including Block Design and Vocabulary; Sattler, 1992), or (d) participant being enrolled in a daily contingency management program or another teacher program addressing behavior or social problems at study entry or in the preceding month. No more than two children per classroom and five classrooms per school were allowed to participate to limit teacher burden and to increase heterogeneity of teacher and school settings involved (Scherbaum & Ferreter, 2009). Figure 1 displays the flowchart of participants.

PR Program (Druk in de Klas)

The PR program consists of a behavioral teacher program addressing ADHD symptoms in the classroom through a teacher manual not requiring additional expert training. The program involves evidence-based elements of behavioral classroom programs (e.g. the Summer Treatment Program; MTA Cooperative Group, 1999) such as psycho-education for the teacher, classroom behavior management strategies, and contingency management (a reward and time-out system; Pelham & Fabiano, 2008). During the 18-week program, students with ADHD symptoms and their classmates are administered a universal program encompassing elements such as physical adjustments within the classroom (e.g. table set-up, creating a time-out corner), positively-formulated classroom rules, effective teacher instructions and teacher strategies to reinforce

appropriate behavior (such as a universal reward system for the entire classroom). Although several techniques will be familiar to most teachers, the manual instructs teachers how to systematically and adequately implement all intervention elements by providing detailed practical instructions on implementation. Six weeks after the start of the program, an individual program for the student with ADHD symptoms may be added to the universal program if the child's ADHD symptoms have not been reduced sufficiently. This is

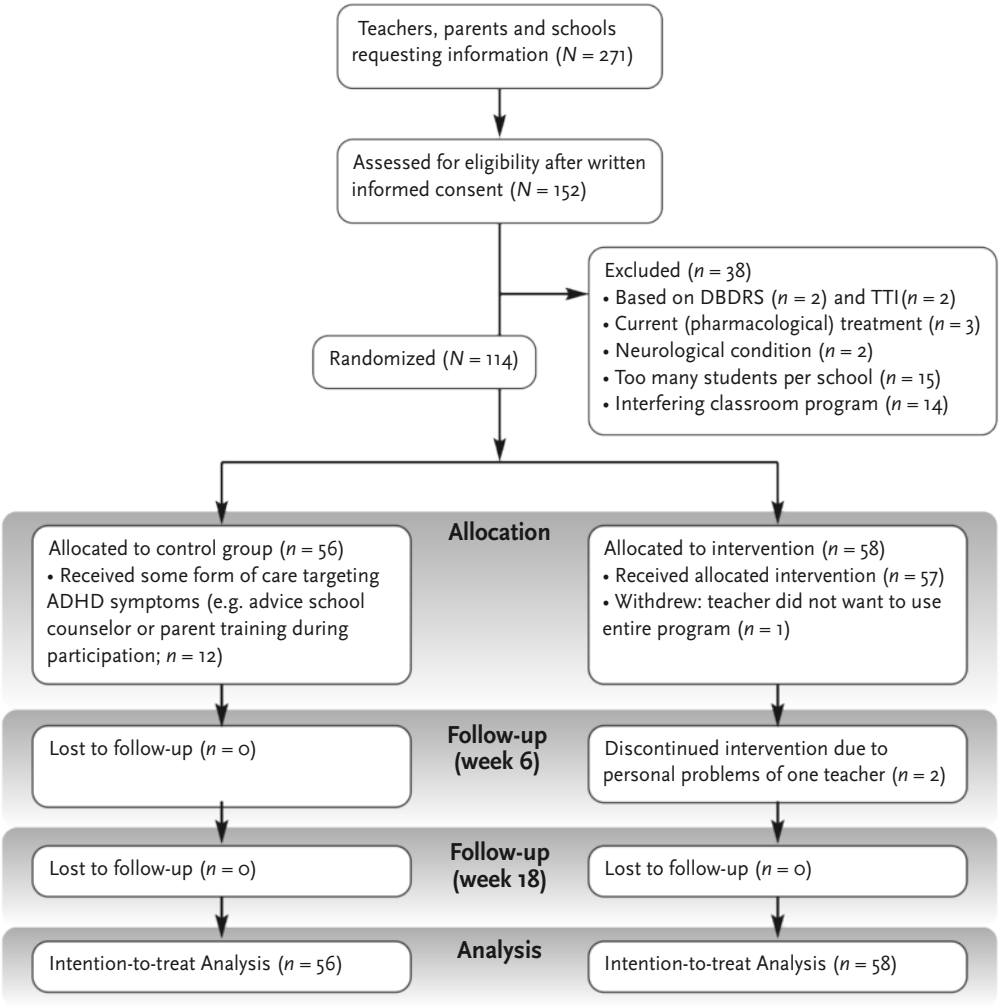

Figure 1. Consolidated Standards of Reporting Trials (CONSORT) flow diagram of participants during enrollment, allocation, follow-up and analysis. DBDRS = Disruptive Behavior Disorder Rating Scale; TTI = Teacher Telephone Interview.

determined by calculating the proportion of behavior change by dividing the student's sum score of all 'below average' and 'far below average' items of the Strengths and Weaknesses of ADHD-symptoms and Normal Behavior scale (SWAN, Teacher version; Swanson, et al., 2006) obtained 6 weeks after start of the program by the sum score of all 'below average' and 'far below average' items obtained at baseline, using a cutoff score of 0.75 (scores ≤ 0.75 indicating sufficient behavior change).

The individual program involves a Daily Report Card (DRC) in which teacher and student with ADHD symptoms set and evaluate mutually-agreed goals (e.g. 'stay seated during individual work' or 'raise your hand before asking questions') to alleviate student's classroom problems. Rewards are provided by the teacher (i.e., through activities or privileges) at the end of each school day within the classroom. The individual program consists of three intensity levels, differing in the number of times per day goals are evaluated (once a day in Level 1 and 3 times a day in Level 2 and 3) and rewards are provided (once a day in Level 1 and 2 and 2 times in Level 3). Every three weeks, the student's behavior is evaluated using the SWAN (teacher version), after which the proportional behavior change (see previous paragraph) is used to determine whether the intensity level needs to be adjusted. Practical examples (for example suitable rewards and positive classroom rules), work sheets (e.g. DRC), flow diagrams (e.g., of the time-out system) and a calendar (weekly schedule of all program elements indicating when to implement each element) facilitate implementation of the program. Although teachers were supposed to use the manual without assistance, they could consult the researcher if necessary, which was done by 15% of the teachers.

Outcome Measures

Program efficacy was assessed using teacher and parent ratings of behavioral, social and emotional functioning. Teachers were aware of treatment allocation as they were responsible for implementing the PR program in their classroom. Parents were aware of treatment allocation since hiding allocation status would have been practically impossible (due to visibility of program elements within the classroom).

ADHD symptoms were assessed using the SWAN (Swanson, et al., 2006). This questionnaire contains 18 items measuring the presence and severity of ADHD symptoms on a continuum, using a 7-point Likert scale ranging from -3 (far above average) to +3 (far below average; Lubke et al., 2007; Young, Levy, Martin,

& Hay, 2009). In the current study, internal consistency for the teacher and parent SWAN was high (Cronbach's α = 0.91 and 0.87, respectively). Psychosocial problems and prosocial behavior were assessed using the Strengths and Difficulties Questionnaire (SDQ; Goedhart, Treffers, & Widenfelt, 2003; Goodman, 1997). This questionnaire consists of 25 items on a 3-point Likert scale (0 = not true, 1 = somewhat true, and 2 = certainly true), divided into five scales: ADHD, Conduct Problems, Emotional Symptoms, Peer Problems, and Prosocial Behavior. Adequate psychometric properties have been reported for the Dutch SDQ (Van Widenfelt, Goedhart, Treffers, & Goodman, 2003).

To assess the child's social functioning, the Social Skills Rating Scale (SSRS) was used (Gresham & Elliott, 1990). The teacher version consists of 30 items divided over three scales (Collaboration, Assertiveness and Self-Control) and the parent version contains 10 extra items related to responsibility for property or work and the ability to communicate with adults. The total scores of the teacher and parent version were used as dependent variables. The child's social functioning was rated on a 3-point Likert scale (0 = never, 1 = sometimes, and 2 = often). Adequate internal consistency and high predictive validity have been reported for the Dutch SSRS (κ = 0.77; Van der Oord et al., 2005).

A teacher questionnaire (available on request) was administered at the end of each week to provide an indication of implementation fidelity. This checklist contains 13 items on a 3-point Likert scale, requiring teachers in the intervention group to indicate whether and to what extent they used each of the intervention elements during that week (0 = not used or inadequate use, 1 = adequate use, and 2 = good use). The average item score was calculated based on all weekly checklists. Acceptable internal consistency was found for this measure (Cronbach's α = 0.67).

Procedure

Teachers and parents were recruited through educational consultant associations, the national parent association for children with developmental problems, and the study's website. Teachers and parents showing interest in participating in the study received an information letter explaining the research aim and responsibilities of all parties involved. In case teachers were interested in participating, they enlisted one or two children displaying ADHD symptoms in their classroom. Written consent was obtained from teachers, parents, and children older than 11 years, after which potential participants were screened for eligibility. ML, who had not been in contact with any participants, was

responsible for the subsequent computer-generated randomization. Although teachers in the intervention group used the universal program in the entire classroom, the effectiveness of the PR program was only investigated for the participating children displaying ADHD symptoms. Outcome variables were assessed 1 week prior to the intervention (T_0), 6 weeks after start of the intervention (T_1) and after 18 weeks at the end of the intervention (T_2). Teachers received financial compensation for their participation in the study (control group: € 50; intervention group: € 125). The study was carried out in the Netherlands between September 2011 and July 2014. Procedures were approved by the medical ethical committee of the Vrije Universiteit Amsterdam.

Statistical Analyses

The software Optimal Design (Raudenbush et al., 2011) was used for sample size estimation. For a repeated-measures multilevel analysis with a maximum of two participants per classroom, a sample size of 116 was calculated to be sufficient, assuming a moderate effect size (d = 0.50) and using an alpha of .05, a power of 80% and an intraclass correlation of 0.10.

Multilevel analyses were conducted using the Statistical Package for the Social Sciences (SPSS) to evaluate effects of the PR program, while using Statistical Analysis System (SAS) for effect size calculation (Selya, Rose, Dierker, Hedeker, & Mermelstein, 2012; Statistics, 2012). All participants were included in the intention-to-treat multilevel analyses. Four hierarchical levels were distinguished: observations at level 1, nested within students (level 2), nested in classrooms (level 3), nested in schools (level 4; Heck, Thomas, & Tabata, 2013). Group was inserted as dichotomous variable, using control group as reference group, and Time was inserted as covariate, which was expressed in number of weeks (0, 6 and 18 weeks for T_0, T_1, and T_2 respectively). The group by time interaction effect was inserted in the model to investigate whether behavior in the intervention group improved more over time compared to the control group. Random time slopes at student-, classroom- or school-level were included if significantly improving model fit using the Likelihood Ratio Test. The Akaike's Information Criteria (AIC) was used to determine which random time slope (student-, classroom- or school-level, respectively) resulted in the best fit (Heck et al., 2013). For the final models with significant group by time interactions, it was assessed whether effects remained significant when controlling for baseline levels of the dependent variables. Effect sizes were calculated using Cohen's f^2 with values of 0.02, 0.15 and 0.35 as thresholds for small, medium and large effects, respectively (Selya et al., 2012). Alpha-level was set at .05.

RESULTS

Table 1 displays demographic characteristics of the intervention and control group. Possible group differences were tested using *t*-tests for continuous variables and chi-square or Fisher's exact tests for categorical variables. No group differences were observed on the screening variables (*p*-values > .26), with two exceptions: (a) there were somewhat more boys in the intervention group ($n = 53$) compared to the

Table 1. Demographic and Clinical Characteristics of Participants ($N = 114$) in Intervention and Control Group

	Intervention group ($n = 58$)	Control group ($n = 56$)
Demographic Characteristics		
Age (years)	8.48 (1.85)	8.25 (1.97)
Gender (% male)*	91% ($n = 53$)	77% ($n = 43$)
IQ	104.02 (11.34)	100.21 (10.41)
SES[a]	3.37 (0.67)	3.24 (0.95)
Race (% Caucasian)	86% ($n = 50$)	82% ($n = 46$)
ADHD diagnosis	10% ($n = 6$)	9% ($n = 5$)
Other psychiatric diagnosis	2% ($n = 1$; CD)	2% ($n = 1$; PDD-NOS)
Parent DBDRS		
Inattention	11.71 (5.23)	10.77 (5.57)
Hyperactivity/Impulsivity	11.79 (5.42)	10.47 (5.49)
ODD	5.88 (3.84)	4.93 (4.00)
CD	0.86 (1.31)	0.90 (1.40)
Teacher DBDRS		
Inattention	14.63 (5.26)	14.90 (5.83)
Hyperactivity/Impulsivity	15.67 (5.35)	15.03 (6.23)
ODD	6.77 (4.75)	5.95 (4.75)
CD	1.43 (1.65)	1.57 (1.90)
TTI		
Inattention	12.50 (6.12)	12.45 (5.34)
Hyperactivity/Impulsivity*	15.62 (6.03)	12.88 (5.78)
Combined	28.12 (8.97)	25.33 (8.34)

Note. *M* and *SD*s are depicted unless stated otherwise. ADHD = Attention-Deficit Hyperactivity Disorder; CD = Conduct Disorder; DBDRS = Disruptive Behavior Disorder Rating Scale; ODD = Oppositional Defiant Disorder; PDD-NOS = Pervasive Developmental Disorder-Not Otherwise Specified; SES = Socioeconomic Status; TTI = Teacher Telephone Interview.

* $p < .05$

[a] SES was measured by parental educational level (average of both parents) through an adapted version of Statistics Netherlands' classification system (1 = primary education, 2 = secondary vocational education, 3 = secondary general education, 4 = undergraduate school, 5 = graduate school; Netherlands Statistics, 2006).

control group (n = 43; $\chi^2(1) = 4.56$, p = .03); and (b) children in the intervention group displayed more symptoms of hyperactivity/ impulsivity as measured by the TTI than controls ($t(112) = -2.32$, p = .02), although scores on the Hyperactivity/ Impulsivity scale of the DBDRS did not differ between groups. For all outcome measures yielding significant group by time interactions, we investigated whether the baseline gender difference could have driven the group by time interactions by including gender into the model (by inserting the main effect, two-way interactions with group and time, and three-way interaction between group, time and gender). The three- and two-way interactions were included if model fit significantly improved or else only gender was included to control for baseline gender differences.

Implementation Fidelity

Teachers reported to have used all elements of the universal program for at least 85% of the time during the 18 intervention weeks (M = 0.88%; SD = 0.11), with the single exception of the element 'provide the child with three compliments after a reprimand is given' which was used on average 61% of the time (SD = 0.37). Most teachers (81%) reported adequate or good implementation of the universal reward system during the entire intervention, with the remaining 19% reporting inadequate implementation in 1 or 2 weeks during the course of the entire 18 weeks. Teachers reported to have used all elements of the Daily Report Card adequately most of the 18 weeks (M = 0.78% of the time; SD = 0.23).

Intervention Effects

Results on all teacher- and parent-rated outcomes are depicted in Table 2. Only group by time interactions are discussed because of our focus on the program's effectiveness, with significant interactions being displayed in Figure 2. Four-level models were used but reduced to three- or two-level models when the intercept variance at a specific level was zero.

ADHD Symptoms

As shown in Figure 2, teachers in the intervention group reported significant reductions of ADHD symptoms during the course of the intervention compared to teachers in the control group, both according to the SWAN ($p < .001$) and the SDQ ADHD (p = .004; see Table 2 for coefficients). The effect size was large for the SWAN (f^2 = 0.37), but small for the SDQ ADHD (f^2 = 0.01). An additional analysis investigating the possible moderating effect of gender on the program's effectiveness revealed no significant better model fit when including the three-way gender by group by time interaction or the two-way interactions (all G^2-values (1) ≤ 0.32, p-values ≥ .564), with similar improvements in favor of the

intervention group when controlling for the main effect of gender ($p < .001$ for the SWAN and $p = .006$ for the SDQ ADHD). Both intervention effects (on the SWAN and SDQ ADHD) remained significant when controlling for baseline levels of ADHD symptoms ($p = .001$ and $p = .023$, respectively). No significant reductions in favor of the intervention or control group were found for parent-rated ADHD symptoms as assessed by the SWAN and the SDQ ADHD ($p = .720$ and $p = .566$, respectively; see Table 2 for coefficients).

Table 2. Multilevel Results on Teacher- and Parent-Rated Behavioral, Social and Emotional Functioning

	Teacher ratings (Coefficient and *SE*)			
	SWAN	**SDQ ADHD**	**SDQ Conduct**	**SDQ Emotion**
Fixed effects				
Constant	-1.378 (0.111)	7.473 (0.272)	2.134 (0.265)	1.982 (0.233)
Group (Time=0)[a]	0.028 (0.156)	0.690 (0.381)	0.707 (0.372)	-0.023 (0.327)
Time	0.009 (0.005)	0.004 (0.018)	0.009 (0.012)	0.016 (0.012)
Group*Time	0.030 (0.008)***	-0.074 (0.025)**	-0.048 (0.017)**[b]	-0.034 (0.017)
Random effects				
σ^2_{u0} (school)	0.079 (0.070)	0.194 (0.369)	-	-
σ_{u01} (school)	-	-0.004 (0.016)	-	-
σ^2_{u1} (school)	-	0.003 (0.001)	-	-
σ^2_{u0} (classroom)	0.144 (0.109)	0.996 (0.580)	1.438 (0.499)	0.289 (0.494)
σ_{u01} (classroom)	-0.005 (0.003)	-	-	-
σ^2_{u1} (classroom)	0.0006 (0.0002)	-	-	-
σ^2_{u0} (student)	0.238 (0.075)	1.005 (0.428)	1.052 (0.393)	1.645 (0.542)
σ^2_{e}	0.098 (0.013)	1.779 (0.213)	1.248 (0.121)	1.335 (0.130)
	Parent ratings			
Fixed effects				
Constant	-0.665 (0.084)	6.365 (0.292)	1.804 (0.224)	2.336 (0.267)
Group (Time=0)[a]	0.012 (0.119)	0.733 (0.411)	0.559 (0.314)	0.060 (0.377)
Time	0.001 (0.003)	-0.024 (0.013)	-0.019 (0.010)	-0.014 (0.013)
Group*Time	0.002 (0.005)	-0.011 (0.019)	-0.006 (0.014)	0.006 (0.019)
Random effects				
σ^2_{u0} (school)	-	-	-	-
σ_{u01} (school)	-	-	-	-
σ^2_{u1} (school)	-	-	-	-
σ^2_{u0} (classroom)	0.044 (0.059)	0.732 (0.637)	-	-
σ_{u01} (classroom)	-	0.031 (0.017)	-	-
σ^2_{u1} (classroom)	-	0.001 (0.001)	-	-
σ^2_{u0} (student)	0.257 (0.068)	2.744 (0.716)	2.010 (0.325)	2.815 (0.453)
σ^2_{e}	0.093 (0.009)	1.238 (0.155)	0.856 (0.085)	1.463 (0.146)

Conduct Problems

A significant reduction of teacher-reported conduct problems was found in the intervention group compared with the control group as measured by SDQ Conduct Problems (p = .004, f^2 =0.04; see Table 2 and Figure 2). Including gender as three- or two-way interaction did not improve model fit (all $G2$-values (1) ≤ 0.43, all p–values ≥ .512) and similar improvements in teacher-reported conduct problems were found for children in the intervention group compared to the control group when controlling for the main effect of gender (p = .006).

	SDQ Peer	**SDQ Prosocial**	**SSRS Social**
	2.236 (0.266)	6.122 (0.301)	32.225 (1.327)
	0.540 (0.373)	-0.715 (0.423)	-2.309 (1.863)
	-0.003 (0.011)	0.021 (0.015)	0.041 (0.063)
	-0.028 (0.016)	0.039 (0.022)	0.269 (0.089)**
	-	0.079 (0.674)	8.852 (8.584)
	-	-	-
	-	-	-
	0.629 (0.655)	0.871 (0.959)	17.862 (14.285)
	-	-	-0.716 (0.408)
	-	-	0.059 (0.028)
	2.256 (0.685)	2.084 (0.730)	37.370 (10.980)
	1.097 (0.106)	2.135 (0.207)	21.814 (2.647)
	1.764 (0.231)	8.189 (0.206)	54.267 (1.358)
	0.084 (0.332)	0.192 (0.290)	-1.876 (1.910)
	-0.016 (0.011)	-0.003 (0.010)	0.043 (0.053)
	0.008 (0.015)	-0.022 (0.014)	0.138 (0.075)
	-	-	0.614 (8.483)
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	2.345 (0.363)	1.721 (0.272)	81.696 (14.774)
	0.956 (0.095)	0.819 (0.081)	24.017 (2.390)

Note.
Emotion = Emotional Problems;
Peer = Peer problems;
SDQ = Strengths and Weaknesses Questionnaire;
SSRS = Social Skills Rating Scale;
SWAN = Strengths and Weaknesses of ADHD-symptoms and Normal Behavior (Total Score);
σ^2_{u0} = Variance of random intercept;
σ_{u01} = Covariance between random intercept and random slope;
σ^2_{u1} = Variance of random slope.
[a] The fixed group effect represents group differences at baseline. The control group was used as reference group.
[b] This effect was no longer significant when controlling for conduct problems at baseline.
*p < .05
**p < .01
***p < .001

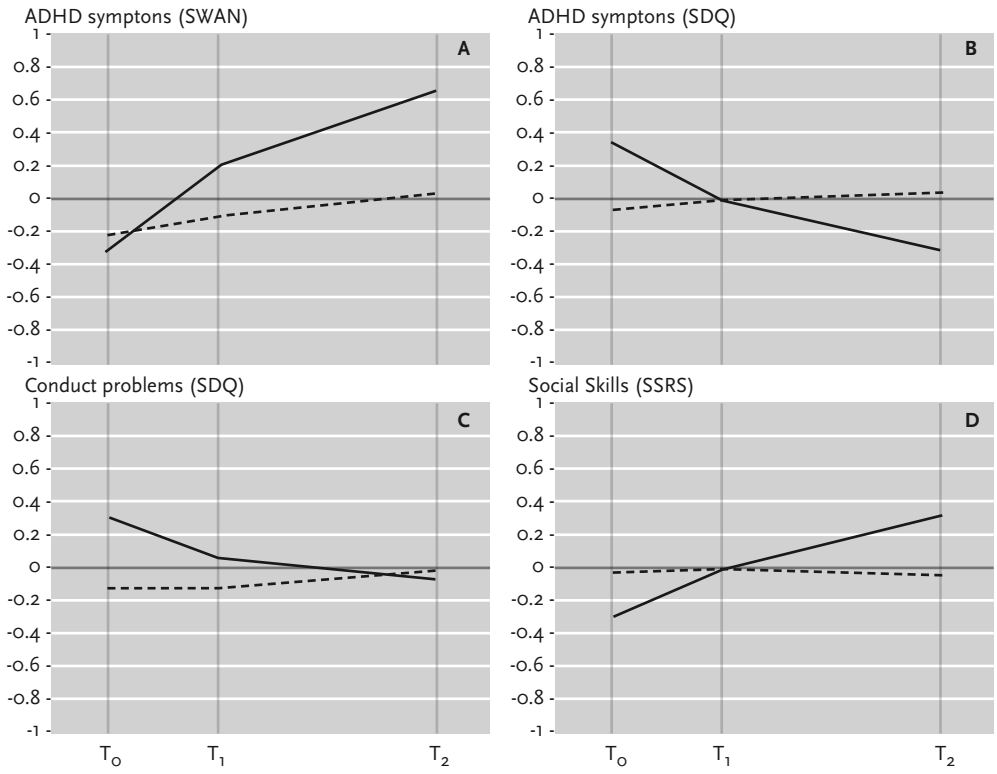

Figure 2. Significant improvements over time for the intervention group (——) compared to control group (- - - - -) demonstrating positive effects of the PR program. Panels A and B depict significant improvements on teacher-rated ADHD symptoms in favor of intervention group on the SWAN (Strengths and Weaknesses of ADHD-symptoms and Normal Behavior) and ADHD scale of the Strengths and Weaknesses questionnaire (SDQ), respectively. Panels C and D reveal significant improvements in favor of intervention group on conduct problems (Conduct scale of SDQ) and on social skills (Social Skills Rating Scale; SSRS), respectively, but the intervention effect on conduct problems was no longer significant when controlling for conduct problems at baseline. For SDQ scales, low scores indicate better performance. For SWAN and SSRS, higher scores indicate better performance.

However, when controlling for conduct problems at baseline, the reduction of conduct problems in the intervention compared to control group was no longer significant ($p = .277$). Parents did not report a significant reduction of SDQ Conduct Problems in favor of one of the two groups ($p = .692$; see Table 2).

Social and Emotional Functioning

Teachers reported a significant improvement of social skills of children in the intervention group compared to children in the control group (SSRS; $p = .003$, $f^2 = 0.04$; see Table 2 and Figure 2). The gender by group by time interaction and the two-way interactions with group or time did not significantly improve model fit (all G^2-values (1) ≤ 1.33, all p–values ≥ .252) and similar improvements in teacher-reported social skills were found in the intervention group compared to the control group when controlling for gender ($p = .002$). The positive intervention effect on social skills remained significant when controlling for social skills at baseline ($p = .040$). No significant improvements in favor of the intervention group were found for teacher-reported Prosocial Behavior ($p = .074$), Emotional Problems ($p = .052$), or Peer Problems ($p = .076$) as assessed by the SDQ (see Table 2 for coefficients). No statistically significant improvements were found for parent-rated SSRS Social Skills ($p = .068$), SDQ Prosocial Behavior ($p = .118$), SDQ Peer Problems ($p = .581$), and SDQ Emotional Problems ($p = .973$; see Table 2 for coefficients).

Discussion

The purpose of this study was to assess the efficacy of the Positivity & Rules Program on teacher- and parent-reported behavioral, social and emotional functioning of children displaying ADHD symptoms at school. Results revealed positive effects on teacher-reported ADHD symptoms and conduct problems, and some positive effects on teacher-rated social skills. Improvements on ADHD symptoms were consistently found for both ADHD scales, although a large effect was found on the SWAN compared to a small effect on the SDQ ADHD. This discrepancy might be explained by higher sensitivity of the SWAN than the SDQ to detect changes in behavior as the SWAN assesses ADHD symptoms on a continuum ranging from severe problems in attentional functioning to extremely well-developed attentional skills (Young et al., 2009). Although results indicated that children in the intervention group displayed a larger decrement in conduct problems than children in the control group, this effect was no longer significant when controlling for baseline differences. The fact that teachers also reported some positive effects on social skills within the rather short intervention period of 18 weeks is most interesting, given that the primary focus of the intervention was on ADHD symptoms. Results on social-emotional functioning were somewhat inconsistent though, with positive effects on the teacher-rated SSRS but not on the SDQ scales assessing social functioning (Prosocial Behavior, Peer Problems, and Emotional Problems). Although additional analyses revealed significant effects for all three SSRS subscales (not reported in

the Results), effects were larger for the Self-Control scale ($f^2 = .04$) than for the Cooperation and Assertion scales ($f^2 = 0.01$ and $f^2 = 0.02$, respectively). This seems consistent with our positive effects on ADHD symptoms as the Self-Control scale involves the capability to control temper in conflict situations (Gresham & Elliott, 1990), which is common in children with ADHD symptoms who often react impulsively (Daley & Birchwood, 2010). Overall, current results indicate that teachers mainly notice improvements in ADHD symptoms after using the PR program, with some improvements in social functioning.

Results are largely consistent with literature on behavioral teacher programs, revealing improvements in ADHD symptoms and social skills, but also in oppositional behavior (Miranda et al., 2002; Östberg & Rydell, 2012; Pelham et al., 2000). As in the current study, effects are generally small (Daley et al., 2014; Sonuga-Barke et al., 2013). Common elements of those effective programs that were also part of the PR program include psycho-education, the use of classroom management strategies, and the use of a reward and time-out system. Treatment options recommended for children displaying ADHD symptoms not meeting full diagnostic criteria are less elaborate than for children diagnosed with ADHD (Subcommittee on Attention-Deficit, 2011). The development of behavioral teacher programs such as the PR program targeting children with ADHD symptoms may contribute to prevent exacerbation of problem behavior and possibly even contributes to a reduction of the number of children ultimately receiving a diagnosis of ADHD, although future research should further investigate this hypothesis.

Despite positive effects observed by teachers, all parent-rated outcomes were non-significant, indicating that no generalization of effects took place to the home setting. This is consistent with earlier work showing that interventions often fail to generalize to non-treatment settings (Abikoff, 2009), and can be explained by our exclusive focus on classroom behavior problems. In order to reduce problem behavior at home, multimodal programs involving additional parent trainings would be most appropriate (Drugli & Larsson, 2006; Östberg & Rydell, 2012).

Sustainability over time is often reported as a challenge difficult to achieve under 'real-world' conditions after research is terminated, while being crucial for program effectivity (Durlak & DuPre, 2008; Han & Weiss, 2005; Wilson et al., 2003). Although future research is necessary to investigate sustainability of the PR program, this intervention could be of great value thanks to several advantages.

The low costs involved in the PR program and the wide target group increases the likelihood of gaining (financial) support from key stakeholders at multiple levels (federal, district and school level), a contextual factor important for long-term sustainability (Coffey & Horner, 2012). Besides that, thanks to the different intensity levels (universal program, and the individual program with three intensity levels) and the practical implementation instructions, the PR program can easily be adapted to changing circumstances (e.g. an increase of behavior problems or changing reward preferences as the child grows older), which is also necessary for a program to be sustainable (Han & Weiss, 2005). Moreover, the limited amount of time required to implement the program is likely to increase teachers' willingness to implement the program (Han & Weiss, 2005). Whereas literature indicates that intensive training and consultation is required for adequate implementation (Coffey & Horner, 2012; Durlak & DuPre, 2008), current results suggest that the PR program was implemented with high fidelity despite the lack of teacher training. Program implementation was assessed through self-report instead of observations, but only 15% of the teachers consulted the helpdesk, which shows that teachers felt capable of implementing the program without additional support. This could be due to teachers being acquainted to some extent with part of the techniques beforehand, and due to the practical examples and work sheets in the manual. Moreover, most teachers (98%) reported that they intended to use the program in the future, indicating a high satisfaction rate and perceived effectiveness of the PR program among teachers.

Current findings should be interpreted in light of some limitations. First, our teacher-rated positive effects are possibly inflated due to our unblinded assessments (i.e., teacher ratings) and by teachers' involvement in treatment delivery, as teachers invested in the program's success or perhaps strongly believed in its efficacy (Jadad & Enkin, 2008). Positive effects of behavioral ADHD programs have been found to disappear when using less-proximate raters not involved in treatment delivery, although effects on conduct problems do persist (Daley et al., 2014; Sonuga-Barke et al., 2013). More objective instruments (e.g. classroom observations) are thus necessary to complement current results. Nonetheless, teachers' perceptions on behavior improvements will likely resort to more positive teacher-child interactions, an important predictor of school functioning (Hoza, 2007). Second, despite random allocation to intervention or control group, there were somewhat more boys in the intervention group than in the control group. Additional analyses, however, revealed that gender did not moderate the positive effects of the PR program and that the

beneficial effects of the PR program remained intact when controlling for gender. Third, treatment fidelity was assessed through teacher self-report rather than an independent classroom observation. Although observations are regarded as more objective and should therefore be preferred (Durlak & DuPre, 2008), practical constraints precluded implementing observations in the current study. Nonetheless, program's beneficial effects and high teacher satisfaction support the high treatment fidelity of our program. Last, future research is necessary to assess whether the program's treatment fidelity can be confirmed through observations and to assess long-term effectiveness.

Conclusion

In conclusion, results of this study show that the PR program improves teacher-rated ADHD symptoms, and provides some beneficial effects on social skills. Implementation fidelity and satisfaction among teachers was high. The program's positive effects await further support by more objective measures in future research, for example, using raters not involved in treatment delivery. Nonetheless, our behavioral teacher program relying on a manual not requiring expert training holds promise for sustainable large-scale implementation and may help to prevent escalation of problem behavior in children with ADHD symptoms.

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CHAPTER 4 Further Insight into the Effectiveness of a Behavioral Teacher Program Targeting ADHD Symptoms using Actigraphy, Classroom Observations and Peer Ratings

ABSTRACT

Objective

The Positivity & Rules program (PR program), a low-intensive behavioral teacher program targeting symptoms of attention-deficit/hyperactivity disorder (ADHD), has shown positive effects on teacher-rated ADHD symptoms and social functioning. This study aimed to assess whether program effects could be confirmed by instruments assessing classroom behavior other than teacher-ratings, given teachers' involvement with the training.

Methods

Participants were 114 primary school children (age = 6-13) displaying ADHD symptoms in the classroom, who were randomly assigned to the treatment (n = 58) or control group (n = 65). ADHD symptoms were measured using classroom observations and actigraphy, and peer acceptance was measured using peer ratings. Intention-to-treat multilevel analyses were conducted to assess program effects.

Results

No beneficial program effects were found for any of the measures.

Conclusion

The earlier beneficial program effects on both ADHD symptoms and social functioning reported by teachers, may be explained by a change in the perception of teachers rather than changes in the child's behavior. Other methodological explanations are also discussed, such as differences between instruments in the sensitivity to program-related changes. The current study underlines the importance of using different measures of classroom behavior to study program effects.

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INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is characterized by age-inappropriate, pervasive and persistent hyperactivity/impulsivity and inattention, resulting in a daily impairment in multiple settings (American Psychiatric Association, 2013). Approximately 5% of all school-aged children are affected by this disorder, which is strongly associated with multiple comorbidities (e.g. oppositional defiant disorder, conduct disorder, and anxiety disorder), and with substantial long-term risks, such as academic or occupational failure, substance abuse, and delinquent behavior (Daley & Birchwood, 2010; Molina et al., 2007; Polanczyk et al., 2007). Similar adversities, albeit in a milder form, are experienced by an additional 11% of all children, displaying ADHD symptoms without meeting full diagnostic criteria (Hong et al., 2014; Willcutt, 2012). Behavioral programs are advised as first-line treatment for ADHD, particularly for children with mild to moderate ADHD and for children with ADHD symptoms not meeting full diagnostic criteria (Atkinson & Hollis, 2010; Pelham & Fabiano, 2008). Given that many children with ADHD symptoms experience problems at school, such as academic problems, disruptive classroom behavior and teacher disobedience (Diamantopoulou et al., 2007), targeting ADHD symptoms in the school setting is an important treatment goal.

For the management of ADHD symptoms in the classroom, behavioral programs are generally preferred by teachers over medication (Girio & Owens, 2009; Pelham et al., 2007). However, most existing behavioral teacher programs are expensive and require extensive training of teachers, which can reduce long-term sustainability of the program (Wilson et al., 2003). The authors of the current study developed the Positivity & Rules program (PR program) (Veenman et al., 2016), a self-help behavioral program targeting ADHD symptoms in the classroom, which relies on a manual and can be used by teachers without additional training. An earlier study showed that the PR program improves teacher-rated ADHD symptoms and social functioning (Veenman et al., 2016). No significant effects were found on teacher-rated conduct problems and peer problems, nor did the positive effects generalize to the home setting. The teacher-rated improvements in ADHD symptoms and social behavior are important as improved behavior in the classroom could set the stage for a better teacher-child interaction, which might, in turn, improve both academic achievement and behavioral adjustment (Baker, 2006; Lassen, Steele, & Sailor, 2006).
The current study examined whether the teacher-observed beneficial effects of the PR program on ADHD symptoms and social functioning could be confirmed by other measures of classroom functioning, as teachers may have been biased

due to treatment involvement (Jadad & Enkin, 2008). Meta-analytic literature (Sonuga-Barke et al., 2013) suggests that effects of behavioral (parent) programs on ADHD symptoms are not corroborated by less-proximal assessments, consisting of raters not involved in treatment delivery (Sonuga-Barke et al., 2013). In order to get further insight into the effectiveness of the PR program, classroom measures other than teacher ratings were used in the current study, including classroom observations, actigraphy, and peer ratings.

Classroom observations are frequently used to assess disruptive classroom behavior and are regarded as the gold standard in research into classroom behavior (Pelham, Fabiano, & Massetti, 2005). A major advantage of classroom observations over questionnaires and rating scales is that behavior is measured as it occurs in the natural school setting, which is likely to enhance ecological validity (Nock & Kurtz, 2005). Many observations such as the Classroom Observation Code (COC; Abikoff & Gittelman, 1985) used in this study, are reliable and able to discriminate hyperactive children from non-hyperactive children, and there is also evidence for the sensitivity of classroom observations to the effects of behavioral and pharmacological interventions (Abikoff, Gittelman, & Klein, 1980; Pelham, Fabiano et al., 2005). Unfortunately, few randomized controlled trials (RCTs) into the effectiveness of behavioral teacher programs for ADHD have used classroom observations (Miranda et al., 2002; MTA Cooperative Group, 1999). The two RCTs that did use classroom observations (Miranda et al., 2002; MTA Cooperative Group, 1999), either failed to report post-treatment data of the control group (Miranda et al., 2002), or did not yield any significant program effects on classroom observations while teacher-rated program improvements were found (MTA Cooperative Group, 1999).

Another example of an instrument that can be used to assess ADHD symptoms in the classroom is actigraphy. Actigraphs are wrist-worn monitors registering movement-induced accelerations used to assess daytime hyperactivity, sleep, and circadian activity rhythms, and are free from many biases associated with classroom observations or questionnaires, such as social desirability, child reactivity or halo effects (Gironda, Lloyd, Clark, & Walker, 2007). Actigraphs have demonstrated higher levels of hyperactivity in hyperactive boys compared to normal controls, not only in clinical settings, but also during structured school activities (e.g., reading or mathematics; Dane, Schachar, & Tannock, 2000; Porrino, Rapoport, Behar, Sceery, et al., 1983). In fact, Porrino and colleagues were able to correctly classify 75% of the participating hyperactive boys and

normal controls, using school activity assessed with actigraphs as outcome. In addition, actigraphs are sensitive to medication effects in hyperactive children (Boonstra et al., 2007; Porrino, Rapoport, Behar, Ismond, & Bunney, 1983). However, to our knowledge, no study has investigated the effects of a behavioral teacher program on hyperactivity using actigraphy.

Peer ratings might be used to assess program effects on classroom social functioning. While teachers using the PR program have not observed effects on peer problems, improvements have been found on teacher-rated social functioning (Veenman et al., 2016). Given these inconsistent results and the overwhelming literature indicating peer difficulties (e.g., more peer rejection and less peer acceptance) in children with ADHD symptoms (Diamantopoulou et al., 2007; Hoza, 2007), we aimed to investigate whether the PR program improved peer acceptance of children with ADHD symptoms. There are several important advantages of peer ratings. Peers observe each other's behavior in diverse contexts (i.e., lunch room, playground) and in the absence of adults, resulting in a more elaborate assessment of social functioning compared to teacher and parent ratings of social functioning (Bukowski, Cillessen, & Velasquez, 2012). In addition, peer ratings are based on the collective knowledge of an entire classroom, thus decreasing biases compared to single source information (Bukowski et al., 2012; Surowiecki, 2004). Despite these advantages of peer ratings, the number of RCTs using peer ratings to assess effects of behavioral teacher programs targeting ADHD symptoms on social functioning is scarce and results are inconsistent (Hoza et al., 2005; Pelham et al., 1993a). One study revealed significant beneficial effects of behavioral modification on peer-rated social functioning (Pelham et al., 1993a). On the contrary, the Multimodal Treatment Study of children with ADHD (MTA) showed that children from all treatment groups (behavior therapy, medication, combined therapy, and community care) remained equally impaired in their peer relationships, despite superior teacher-rated social functioning in the group receiving combined therapy (Hoza et al., 2005).

The current study was designed to assess whether earlier effects of the PR program on teacher-rated ADHD symptoms and social functioning could be confirmed by other classroom measures, using actigraphy, classroom observations, and peer-ratings. Based on the teacher-reported improvements on ADHD symptoms (Veenman et al., 2016), a reduction of actigraphic hyperactivity and of classroom-observed ADHD symptoms was expected. Given the inconsistent effects of the PR program on social functioning

(improvement on teacher-rated social functioning but no effects on teacher-rated peer problems; Veenman et al., 2016), no specific hypothesis was formulated for this outcome measure.

METHODS

Participants

The study sample comprised 114 primary school children (6-13 years) displaying high levels of ADHD symptoms in the classroom (see Veenman et al., 2016). Participants were randomly assigned at school level to the treatment group receiving the PR program (n = 58 from 44 classrooms of 30 schools; 91% male), or the control group (n = 56 from 43 classrooms of 34 schools; 77% male) that was allowed to receive care as usual.

Inclusion criteria were: (a) high levels of ADHD symptoms (> 90th percentile) as reported by the child's teacher on the Hyperactivity/Impulsivity and/or Inattention scale of the Disruptive Behavior Disorders Rating Scale (DBDRS; Oosterlaan et al., 2008; Pelham et al., 1992), and (b) at least three clinical and three subthreshold ADHD symptoms on the Teacher Telephone Interview (TTI; Holmes et al., 2004), a semi-structured interview based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 2000). Exclusion criteria were: (a) IQ < 80 estimated using a short version of the Wechsler Intelligence Scale for Children (WISC-III, including Block Design and Vocabulary; Sattler, 1992); (b) a neurological or severe physical condition interfering with daily functioning; (c) treatment for ADHD (including medication) at study entry or in the preceding 6 months, or (d) participant being enrolled in a daily behavioral teacher program or another teacher program addressing behavior or social problems at study entry or in the preceding month. The latter two exclusion criteria were used to assure assessing the isolated effects of the PR program. No more than two children per classroom and five classrooms per school were allowed to participate to limit teacher burden and to increase heterogeneity of teacher and school settings involved (Scherbaum & Ferreter, 2009). Figure 1 displays the flowchart of participants.

Positivity & Rules Program (Druk in de Klas)

The PR program consists of a behavioral teacher program addressing ADHD symptoms in the classroom through a teacher manual without additional expert training (see also Veenman et al., 2016). The 18-week program involves common elements of evidence-based behavioral programs (e.g., Summer Treatment Program; MTA Cooperative Group, 1999) such as psycho-education for the

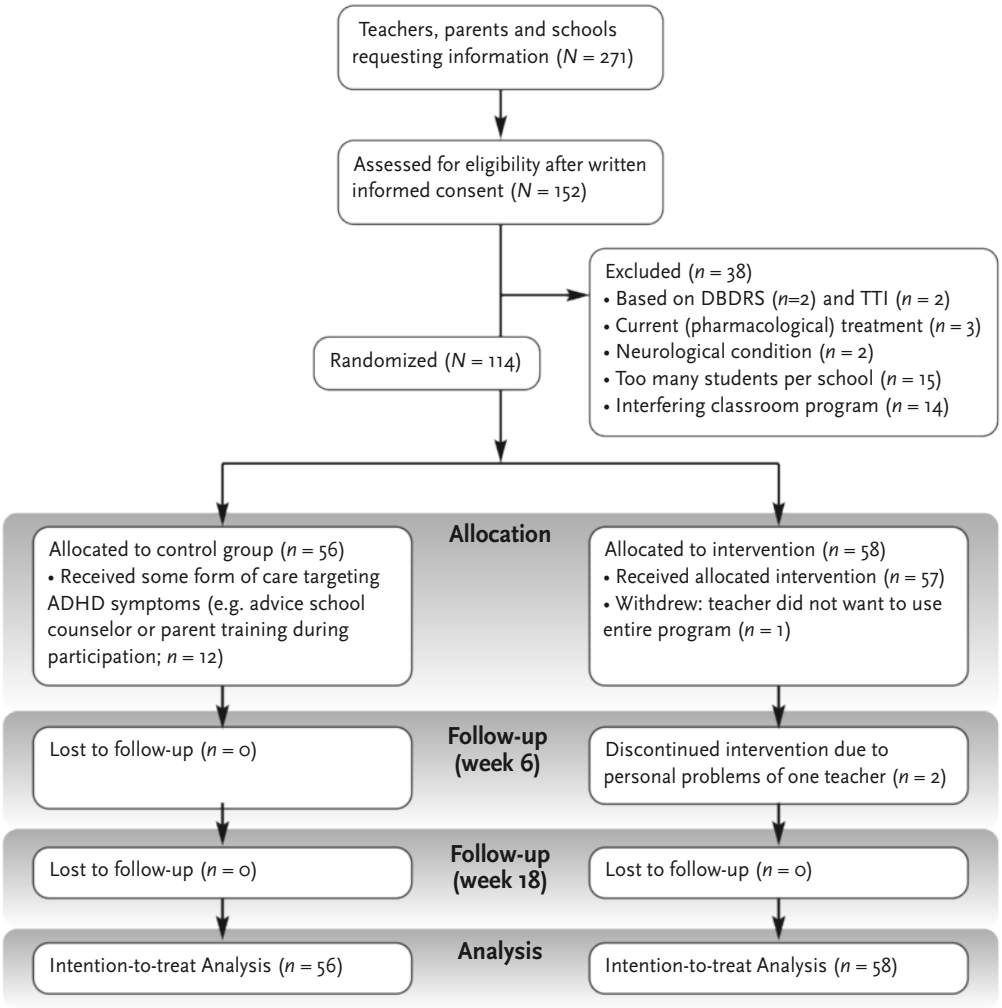

Figure 1. Consolidated Standards of Reporting Trials (CONSORT) flow diagram of participants during enrollment, allocation, follow-up and analysis. DBDRS = Disruptive Behavior Disorder Rating Scale; TTI = Teacher Telephone Interview. Reprinted with permission of SAGE publishing from Veenman et al. (2016).

teacher, and classroom behavior management strategies comprising both antecedent and consequent behavioral techniques (e.g., positively-formulated classroom rules, effective teacher instructions, universal reward system and time-out; Pelham & Fabiano, 2008). While these behavioral techniques were administered to the entire classroom (i.e., to the children with ADHD symptoms and to their classmates), an individual program with three intensity levels was

available for children with ADHD symptoms that consisted of a Daily Report Card. Although several techniques will be familiar to many teachers, the manual instructs teachers on how to systematically and adequately implement all program elements by providing detailed practical instructions on implementation (including work sheets, flow diagram and agenda). For more information about the PR program, see our previous study (Veenman et al., 2016).

Outcome Measures

Actigraphy and classroom observations were used to assess the effects of the PR program on ADHD symptoms in the classroom, while peer ratings were used to assess whether peer acceptance improved after use of the program.

Actigraphy

Hyperactivity at school was measured by small (37 mm x 29 mm x 10 mm), light-weight (16 gram) actigraphs (Actiwatch 4, Philips Respironics, Murrysville, PA, United States), detecting the highest movement-induced accelerations (0.5-7.0 Hz) during 15-s intervals, generating a transient voltage signal proportionate to the acceleration rate (Cambridge Neurotechnology, 2008; Chen & Bassett, 2005). Good inter-unit reliability (concordance between actigraphs worn at the same body parts) and convergent validity with a validated three-dimensional motion-tracking system has been established (Gironda et al., 2007). Intra-unit reliability of the actigraphs used in this study, calculated as the correlation of average activity counts per minute of each actigraph between all school days, was good (Cronbach's $\alpha = .77$).

The actigraphs were worn on the non-dominant hand during seven consecutive days, of which the five school days were used to assess hyperactivity at school. As school hours are similar across schools in the Netherlands, the selected hours for data-analysis were kept similar for every child: 9:00-15:00 on Monday, Tuesday, Thursday and Friday, and 9:00-12:00 on Wednesday. For Grade 1 and 2 (40% of all children), data from Friday afternoon (12:00-15:00) were excluded because at most schools, school ends at 12.00 on Fridays in these grades. Data for days on which scores were missing (e.g., due to technical failure or participant non-adherence) or special non-academic events (e.g., holiday, school trip or illness) were also excluded. This resulted in 25.5% of missing data, which is similar to other studies using actigraphy (Acebo et al., 1999; Ustinov & Lichstein, 2011). Average activity counts per minute during the school hours across five school days served as the dependent measure and was calculated using Respironics Actiware software (Version 5.71.0; Philips Respironics, Murrysville, PA, United States).

Classroom Observation

Children were observed in the classroom during structured academic lessons (i.e., teacher instructions or individual work during academic tasks, such as mathematics and writing) using the COC (Abikoff & Gittelman, 1985). The COC was administered as in the original form (1985), during 2 blocks of 8 minutes, divided into 15-s intervals. As the dependent measure in our analyses, the observed behavior rate (i.e., mean percentage of intervals in which behavior occurred) of Interference (Interference and Interference to Teacher measuring impulsivity), Off-Task (measuring inattention) and Gross Motor-all (Gross Motor-standing and –vigorous measuring hyperactivity) were summed into one ADHD-composite score as done previously in other treatment studies (Abikoff et al., 2004; Klein & Abikoff, 1997).

Participants were observed by pairs of two trained raters who were not blind to treatment allocation of the child due to visibility of program elements in the classroom. Observers received an elaborate training that consisted of didactic lessons and scoring in vivo. The COC has been shown to discriminate children with ADHD from typically developing peers (Abikoff et al., 2002), and has been shown sensitive to treatment effects (Abikoff et al., 2004). High inter-rater reliability has been reported for all categories of the COC (φ = .80 – 1.00, M = .91; Abikoff et al., 2002).

Peer Acceptance

The child's social acceptance by peers in the classroom was measured through peer ratings, requiring each student to indicate the likability of all classmates on a 5-point Likert scale from 1 (dislike very much) to 5 (like very much; Pelham et al., 2000). The participant's average peer score was used as dependent measure, by summing the scores of all classmates and then dividing this total score by the number of children in the classroom. Test-retest reliability of this measure was high (r = .72) and validity of peer ratings as measure of social acceptance has been demonstrated against teacher-rated social acceptance (Maassen, Van der Linden, Goossens, & Bokhorst, 2000; Wu, Hart, Draper, & Olsen, 2001).

Implementation Fidelity

A teacher questionnaire (available on request) was administered at the end of each week to acquire an indication of implementation fidelity. This checklist contains 13 items on a 3-point Likert scale, requiring teachers in the treatment group to indicate whether and to what extent they used each of the program elements during that week (0 = not used or inadequate use, 1 = adequate use,

and 2 = good use). The average item score was calculated based on all weekly checklists. Internal consistency for this measure was acceptable (Cronbach's $\alpha = .67$).

Procedure

This study was conducted in the Netherlands between September 2011 and July 2014. Teachers and parents were recruited through educational consultant associations, the national parent association for children with developmental problems, and the study's website. Teachers and parents showing interest in participating in the study received an information letter explaining the research aim and responsibilities of all parties involved. In case teachers were interested in participating, they enlisted one or two children displaying ADHD symptoms in their classroom. Written informed consent was obtained from all parents, teachers, and children older than 11 years. Children were screened for eligibility by the first author BV. ML, not in contact with any of the children, was responsible for the subsequent computer-generated randomization (replacement randomization, without stratification) to allocate children to the treatment or control group. Although teachers in the treatment group used the universal program in the entire classroom, the effectiveness of the PR program was only investigated for the participating children displaying ADHD symptoms. Dependent variables were measured at baseline (T_0; week 0), 6 weeks after starting the PR program (T_1), and after 18 weeks at the end of the program (T_2). Financial compensation was given to all participating teachers (control group: € 50; treatment group: € 125). This study was carried out in accordance with the recommendations of the medical ethical committee of the Vrije Universiteit Amsterdam with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the medical ethical committee of the Vrije Universiteit Amsterdam (reference number 2011/196).

Statistical Analyses

Sample size estimation was performed using the software Optimal Design (Raudenbush et al., 2011). Assuming a moderate effect size of 0.50, a sample size of 116 was calculated to be sufficient for a repeated-measures multilevel analysis with a maximum of two participants per classroom, using an alpha of .05, a power of 80% and an intraclass correlation of 0.10.

To evaluate the effects of the PR program, multilevel analyses were conducted using the Statistical Package for the Social Sciences (SPSS; IBMCorp, 2011). All

randomized subjects participated in the intention-to-treat analyses, regardless of the amount of missing data. For none of the measures, the percentage of missing data exceeded 5% (5.0% for classroom observations and for teacher ratings on implementation fidelity, and 4.7% for peer ratings), except for actigraphy for which 25.5% of data were missing (see subheading Actigraphy). Four hierarchical levels were used: observations at level 1 were nested within students (level 2), level 2 was nested within classrooms (level 3), and level 3 was nested within schools (level 4; Heck et al., 2013). Group was used as fixed factor with control group as reference group. Time was used as fixed factor and was expressed in number of weeks (0, 6, and 18 weeks for T_0, T_1, and T_2, respectively). The interaction between group and time was used to evaluate whether behavior of children in the treatment group improved more over time compared to children in the control group. Analyses controlled for baseline levels of the dependent variables and gender differences (there were more boys in the treatment group; see Results), inserting gender as fixed factor (with boys as reference group). The Likelihood Ratio Test and Akaike's Information Criteria (AIC) were used to determine whether random time slopes at student-, classroom- or school-level needed to be included for providing better model fit (Heck et al., 2013). Alpha-level was set at .05.

RESULTS

Sample characteristics of the treatment and control group are displayed in Table 1. No group differences were found on age, IQ, socioeconomic status, race, the presence of ADHD or other psychiatric diagnoses, parent- and teacher-rated ADHD symptoms assessed with DBDRS, and inattention and combined ADHD symptoms assessed with the TTI (*p*-values > .261). However, children in the treatment group were more likely to be boys ($\chi^2(1) = 4.56$, $p = .033$), and received higher ratings of hyperactive/impulsive behavior on the TTI ($t(112) = -2.32$, $p = .022$). All subsequent analyses controlled for gender differences and for baseline levels of the dependent variable (see below).

Implementation Fidelity and Teacher Satisfaction

Most teachers (81%) reported adequate or good implementation of the universal reward system during the entire program, with the remaining 19% reporting inadequate implementation in 1 or 2 weeks during the course of the entire 18 weeks. Teachers reported to have used all elements of the DRC adequately most of the 18 weeks ($M = 0.78$% of the time; $SD = 0.23$). The helpdesk was consulted by 30% of the teachers and mainly received questions regarding the use of the time-out and the reward system for the entire classroom or individual children.

Table 1. Demographic and Clinical Characteristics of Participants ($N = 114$) in Treatment and Control Group

	Treatment group ($n = 58$)	Control group ($n = 56$)
Demographic Characteristics		
Age (years)	8.48 (1.85)	8.25 (1.97)
Gender (% male)*	91% ($n = 53$)	77% ($n = 43$)
IQ	104.02 (11.34)	100.21 (10.41)
SES[a]	3.37 (0.67)	3.24 (0.95)
Race (% Caucasian)	86% ($n = 50$)	82% ($n = 46$)
ADHD diagnosis	10% ($n = 6$)	9% ($n = 5$)
Other psychiatric diagnosis	2% ($n = 1$; CD)	2% ($n = 1$; PDD-NOS)
Parent DBDRS		
Inattention	11.71 (5.23)	10.77 (5.57)
Hyperactivity/Impulsivity	11.79 (5.42)	10.47 (5.49)
ODD	5.88 (3.84)	4.93 (4.00)
CD	0.86 (1.31)	0.90 (1.40)
Teacher DBDRS		
Inattention	14.63 (5.26)	14.90 (5.83)
Hyperactivity/Impulsivity	15.67 (5.35)	15.03 (6.23)
ODD	6.77 (4.75)	5.95 (4.75)
CD	1.43 (1.65)	1.57 (1.90)
TTI		
Inattention	12.50 (6.12)	12.45 (5.34)
Hyperactivity/Impulsivity*	15.62 (6.03)	12.88 (5.78)
Combined	28.12 (8.97)	25.33 (8.34)
Outcome measures		
Actigraphy (AC/min)	734.24 (223.54)	730.79 (188.16)
Classroom-observed ADHD symptoms	25.33 (19.26)	21.59 (18.64)
Peer acceptance	3.17 (0.68)	3.24 (0.71)

Note. *M* and *SD*s are depicted unless stated otherwise.
AC/min = Activity Counts per minute;
ADHD = Attention-Deficit Hyperactivity Disorder;
CD = Conduct Disorder;
DBDRS = Disruptive Behavior Disorder Rating Scale;
ODD = Oppositional Defiant Disorder;
PDD-NOS = Pervasive Developmental Disorder-Not Otherwise Specified;
SES = Socioeconomic Status;
TTI = Teacher Telephone Interview.

[a] SES was measured by parental educational level (average of both parents) through an adapted version of the Dutch classification system (1 = primary education, 2 = secondary vocational education, 3 = secondary general education, 4 = undergraduate school, 5 = graduate school; Verhage, 1983).
*$p < .05$.

Satisfaction rate was high: 98% of the teachers intended to use the entire program or most important program elements in the future (71 and 27%, respectively).

Effectiveness PR Program

Multilevel results are depicted in Table 2. For all outcomes, four-level models were reduced to three-level models as intercept variance was zero at school level.

Actigraphic Hyperactivity

At baseline, children in the treatment group showed similar levels of hyperactivity as assessed by actigraphy compared to controls (p = .932). Hyperactivity did not change over time (p = .763; see Table 2 for coefficients), nor were time slopes significantly different for children in the treatment group and control group (p = .864) when controlling for baseline hyperactivity and gender differences.

Classroom-Observed ADHD Symptoms

Results on the classroom-observed ADHD-composite showed that children in the treatment and control group displayed similar levels of ADHD symptoms at baseline (p = .300). ADHD problems did not change over time (p = .555), nor were time slopes significantly different for children in the treatment group and control group (p = .693) when controlling for baseline ADHD symptoms and gender differences.

Peer Acceptance

Children in the treatment and control group displayed similar levels of peer acceptance at baseline (p = .628). Peer acceptance improved over time (p = .008), but this improvement was similar for children in the treatment group and control group (p = .760) when controlling for peer acceptance at baseline and gender differences.

Correlations between Instruments

To study the inconsistency between the positive effects of the PR program on teacher ratings and the classroom measures showing no effects in the current study, exploratory correlational analyses were performed at baseline between ADHD measures of this study and of our previous study (Veenman et al., 2016).

Hence, classroom-observed ADHD symptoms and actigraphic hyperactivity were both correlated with teacher-rated ADHD symptoms as measured by the Strengths and Weaknesses of ADHD-symptoms and Normal Behavior scale

	ADHD symptoms (observation)			Hyperactivity (actigraph)[a]			Peer acceptance		
	Coefficient	*SE*	*p*-value	Coefficient	*SE*	*p*-value	Coefficient	*SE*	*p*-value
Fixed effects									
Constant	14.649	3.833	<.001	326.929	55.046	<.001	0.465	0.120	<.001
Baseline level of DV	0.278	0.069	<.001	0.527	0.060	<.001	0.830	0.033	<.001
Gender (Boys=0)	-4.435	4.555	.215	-21.745	33.342	.515	-0.024	0.059	.687
Group (Time=0)[b]	1.635	4.837	.736	16.919	46.423	.716	0.139	0.077	.071
Time	-0.140	0.236	.555	0.699	2.318	.763	0.012	0.004	.008
Group*Time	0.133	0.337	.639	0.565	3.285	.864	-0.002	0.006	.760
Random effects[c]									
σ^2_{u0} (classroom)	40.675	33.813		-	-		0.052	0.011	
σ^2_{u0} (student)	30.645	37.966		4938.676	2558.918		0.086	0.014	
σ_{u01} (student)	-	-		-	-		-0.008	0.001	
σ^2_{u1} (student)	-	-		-	-		.0001	.0001	
σ^2_e	211.746	29.281		17830.428	2724.235		0.051	0.007	

Table 2. Multilevel Results on ADHD Symptoms and Peer Acceptance

Note. ADHD = Attention-Deficit Hyperactivity Disorder; DV = Dependent Variable.

σ^2_{u0} = Variance of random intercept;

σ_{u01} = Covariance between random intercept and random slope;

σ^2_{u1} = Variance of random slope.

[a] Average hyperactivity at school in Activity Counts per minute.

[b] The fixed group effect represents group differences at baseline. The control group was used as reference group.

[c] Only the random intercepts and random time slopes that were part of any of the final models are depicted in this Table.

(SWAN; Swanson et al., 2006). Similarly, peer acceptance was correlated with teacher ratings assessing peer problems (i.e., Peer Problems Scale of the Strengths and Weaknesses Questionnaire, SDQ; Van Widenfelt et al., 2003) and general social functioning (i.e., Social Skills Rating Scale; Gresham & Elliott, 1990). Results showed that both classroom-observed ADHD symptoms and actigraphic hyperactivity did not significantly correlate with teacher-rated ADHD symptoms (SWAN Total score; r = -0.12, p = .230 and r = -0.18, p = .075, respectively). As actigraphy measures hyperactivity rather than general ADHD symptoms, the correlation between actigraphic hyperactivity and the SWAN Hyperactivity/Impulsivity scale (teacher version) was also assessed, yielding a significant, small-to-moderate correlation (r = -0.25, p = .012, R^2 = 0.06). Results revealed a large and significant correlation between peer acceptance and

teacher-rated peer problems (i.e., Peer Problems Scale of the SDQ; $r = -0.53$, $p < .001$, $R^2 = 0.28$), and a medium to large correlation between peer acceptance and teacher-rated general social functioning ($r = 0.37$, $p < .001$, $R^2 = 0.14$).

DISCUSSION

This study aimed to assess whether earlier reported teacher-rated effects of the PR program on ADHD symptoms and social functioning (Veenman et al., 2016) could be confirmed by other classroom measures of ADHD symptoms and social functioning, using actigraphy, classroom observations and peer ratings. For none of these measures beneficial effects of the PR program were found. The current findings are in line with literature indicating that positive effects of behavioral (parent) programs on ADHD symptoms are not confirmed by less-proximal instruments rather than parents who were involved in treatment delivery (Daley et al., 2014; MTA Cooperative Group, 1999; Sonuga-Barke et al., 2013). Regarding peer acceptance, improvement was unrelated to use of the PR program. This result is in accordance with earlier findings showing no beneficial effects of behavioral treatments and treatments combining behavioral and medication therapy on peer problems, despite improvements on teacher-rated social functioning (Hoza et al., 2005; Pelham et al., 1993a; Veenman et al., 2016).

Our results suggest that the teacher-reported effects might reflect a change in perception of the teacher regarding the child's functioning, rather than actual behavioral changes within a child, which could not be captured by the other measures used in the current study (i.e., classroom observations, actigraphy or peer ratings). This change in teachers' perception could be explained by teachers being biased due to their investment in the program and subsequent positive treatment expectations (Sonuga-Barke et al., 2013). An alternative explanation is that teachers show increased tolerance or coping with ADHD symptoms (Daley et al., 2014), for example due to the psycho-education, which has been found to increase positive attitudes and behavior toward individuals with ADHD (Nussey, Pistrang, & Murphy, 2013).

One partial explanation for the absence of significant program effects in the current study, might be related to the degree of severity of our sample. Children in our study all showed high levels of ADHD symptoms, but children receiving treatment for ADHD were excluded. As a result, only 10% were diagnosed with ADHD and 2% had a comorbid psychiatric diagnosis. Consequently, the room for improvement in terms of ADHD symptoms was lower in our sample compared to clinical ADHD samples, which may have added to the non-significant treatment effects for the current dependent variables.

Another methodological explanation for the lack of significant program effects on the ADHD measures should also be considered. The low correlations between teacher-rated ADHD measure in our previous study and the ADHD measures of the current study (classroom observation and actigraphy) suggest that these measures pertain to different aspects of the child's behavior. With regard to the wrist-worn actigraphs, this measure mainly registers upper limb movements (Kumahara, Tanaka, & Schutz, 2004), whereas teacher-rated Hyperactivity/Impulsivity concerns more than just upper-limb hyperactivity and also involves impulsivity, such as difficulty awaiting turns. Another aspect inherent to actigraphic measurements is their inability to distinguish inappropriate hyperactivity from appropriate activity, such as raising hands before asking a question. This illustrates the difficulty of using actigraphs to assess effects of behavioral programs targeting hyperactivity. Waist- or ankle-worn actigraphs could be a more appropriate measure of general activity (Gironda et al., 2007), and might therefore be more suitable to investigate whether behavioral programs reduce hyperactivity in the classroom. With regard to the classroom observations, the validity might have been limited by the narrow time frame within which observations took place (2 x 8 min in a structured setting) compared to teacher ratings (SWAN) that were based on behavior shown in the last 4 weeks (Sonuga-Barke et al., 2013). The absence of program effects on the current less-biased ADHD measures despite teacher-rated improvements of the PR program, may thus be related to the different behavioral aspects measured by these instruments.

The lack of program effects on peer acceptance in our current study is in line with the lack of effects of the PR program on teacher-rated peer problems and could have been expected as the PR program focused on improving ADHD symptoms rather than improving peer problems (Veenman et al., 2016). These findings are also in accordance with the MTA study, in which sociometric outcomes were resistant to both medication and behavioral therapy (Hoza et al., 2005). The current results suggest that targeting child behavior is insufficient to change peer status, particularly in short interventions such as this 18-week program. Peer rejection is highly stable and stability of negative peer perception is not only explained by the behavioral problems of the rejected child itself, but also by peer group influences such as social devaluation, exclusionary behavior and reputational bias (Mikami & Normand, 2015). For example, peers can socially devalue children with ADHD symptoms because they are dissimilar from other classmates and are viewed as being responsible for their own actions (Hinshaw, 2005). Peers can also display exclusionary behavior to disliked

children (e.g., saying mean things about the child within earshot or spreading lies), thus exacerbating peer problems and fueling peer rejection by other classmates (Perry, Kusel, & Perry, 1988; Reuland & Mikami, 2014). Besides that, peers can attribute behavior improvement of rejected children to external and unstable factors (Hymel, 1986) and are likely to interpret ambiguous behavior of disliked children as hostile, while evaluating similar behavior of beloved children more positively (Peets, Hodges, & Salmivalli, 2008). Hence, improving the behavior of children with ADHD symptoms is probably insufficient to reduce peer rejection. Teachers should engage in strategies that directly focus on changing peer culture, such as the intervention Making Socially Accepting Inclusive Classrooms (MOSAIC; Mikami et al., 2013), to improve peer acceptance.

It could be argued that additional expert involvement could have improved the effectiveness of the PR program, but literature on this topic is inconsistent. While a review on the effectiveness of self-help interventions for parents of children with behavior problems suggests that adding minimal levels of therapeutic support improves child outcomes (O'Brien & Daley, 2011), another meta-analytic study suggests that self-help parenting interventions are equally effective compared to therapist-led parenting interventions (Tarver, Daley, Lockwood, & Sayal, 2014). So far, no studies have investigated the added effects of therapist support to low-intensive teacher programs. More research is needed to assess whether the effectiveness of the PR program can be improved through therapist involvement.

A few limitations of our study should be noted. First, observers were not blind to treatment allocation due to the visibility of some program elements within the classroom. Although this could have resulted in observer's bias, results were probably not influenced because no program-related effects in favor of the treatment group were found. Another limitation of the PR program is that implementation fidelity of teachers was measured by self-report instead of independent classroom observations (see also Veenman et al., 2016). Third, treatment expectations were not assessed, which prevented us from investigating whether the discrepancy between current results and earlier significant teacher-reported effects could be explained by an expectation effect of teachers in the treatment group.

Conclusion

This study is unique in its use of classroom observations, actigraphy and peer ratings to investigate whether earlier teacher-reported effects of the PR teacher

program on ADHD symptoms and social functioning could be confirmed by other classroom measures. Results showed that improvements in teacher-rated ADHD symptoms were not confirmed by either actigraphy or by classroom observations. Possibly, the PR program improves teachers' perception of a child's behavior, rather than the child's behavior. However, the possibility that the current measures assess different aspects of classroom behavior than teacher ratings should not be ruled out either, nor the potential influence of other methodological explanations (e.g. limited sensitivity to program-related improvements on ADHD symptoms). Either way, improving teachers' perception may be an important step to enhance teacher-child interaction, which is in turn essential for the child's behavioral, social and academic functioning at school and thus for future success in life (Baker, 2006; Stuhlman & Pianta, 2002). Future studies should thus assess the effect of the PR program on teacher-child interaction.

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CHAPTER 5 Moderators Influencing the Effectiveness of a Behavioral Teacher Program

ABSTRACT

Objective

This study assessed which moderators influenced the effectiveness of a low-intensive behavioral teacher program for children with symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD).

Methods

Primary school children ($N = 114$) with ADHD symptoms in the classroom were randomly assigned to the intervention program ($n = 58$; 91% male) or control group ($n = 56$; 77% male). Multilevel regression analyses assessed differential treatment gains of the intervention program in terms of ADHD symptoms and social skills. Moderators included demographic characteristics (gender, age, parental educational level), severity and comorbidity of problem behavior (ADHD symptoms, conduct and internalizing problems), social functioning, and classroom variables (teaching experience, class size).

Results

Results revealed larger program effects for older children and children from highly educated families and smaller beneficial effects for children with comorbid conduct or anxiety problems.

Conclusion

The intervention program seems more beneficial for highly educated families and children without comorbid problem behavior. More intensive treatments appear necessary for children facing additional challenges.

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INTRODUCTION

There is a large body of evidence indicating that children with attention-deficit hyperactivity disorder (ADHD) benefit from behavioral teacher programs (for reviews, see Evans et al., 2014; Gaastra et al., 2016). However, the impact of such programs may differ, depending on, for example, characteristics of a child (Hinshaw, 2007). Identifying moderators of treatment success could assist teachers and other educational professionals to determine which students might benefit best from behavioral teacher programs.

The Positivity & Rules program is a manualized behavioral self-help program for teachers (PR program; Veenman et al., 2016) targeting ADHD symptoms in the classroom. The program does not require additional teacher training, which fosters long-term sustainability at little cost. The practical and easy-to-use manual includes a universal program involving psycho-education, classroom management and behavioral strategies (e.g., reward and time-out system), and a Daily Report Card to target specific behavioral goals in individual children. Beneficial effects of the PR program have been reported on teacher-rated ADHD symptoms and social skills (Veenman et al., 2016). In line with meta-analytic literature indicating that positive program effects are often restrained to proximate measures (Sonuga-Barke et al., 2013), the positive program effects were not present for less-proximate measures (i.e., actigraphy, classroom observations and peer ratings; Veenman, Luman, & Oosterlaan, 2017). Given the paucity of low-intensive behavioral teacher programs, the PR program could be a valuable contribution to existing intervention options. Therefore, the aim of this study was to identify moderators of treatment outcome of the PR program to determine which children could benefit most from the PR program.

Based on the available literature, both child and classroom characteristics were selected that might moderate the effectiveness of the PR program. Regarding demographic characteristics, the moderating effects of age and gender are worth investigating given the age-dependent decline of ADHD symptoms and conduct problems (Faraone, Biederman, & Mick, 2006; Lahey et al., 2000) and gender-specific manifestation of problem behavior, with less externalizing and more internalizing problems in girls than in boys (Gershon & Gershon, 2002). Regarding age, results are inconsistent, with some (meta-analytic) evidence suggesting that older children might profit more from (parent-based) behavioral programs (Comer et al., 2013; van den Hoofdakker, et al., 2010) and other (meta-analytic) evidence indicating no moderating effect of age (Beauchaine, Webster-Stratton, & Reid, 2005; Enebrink et al., 2012; Lundahl et al., 2006; Thijssen, Vink,

Muris, & de Ruiter, 2017). Regarding gender, results are also inconclusive. No moderating effect of gender was found in the Multimodal Treatment Study that compared the effectiveness of medication treatment, behavior management, combined treatment (medication and behavior management), and care as usual, nor in the internet-based parent program of Enebrink and colleagues (Enebrink et al., 2012; MTA Cooperative Group, 1999). However, superior treatment effects for boys with aggressive and oppositional behavior have been found in two other studies involving a behavioral classroom intervention (Good Behavior Game; Kellam et al., 2008; Witvliet et al., 2009) and in a low-intensive version of the Incredible Years behavioral parent program (Lavigne, et al., 2008). An explanation for the larger program effects for boys might be that there is more room for improvement given their higher levels of externalizing behavior problems (Gershon & Gershon, 2002). Differential treatment response may also depend on parental educational level as it seems that families with limited social and economic resources are less likely to benefit from behavioral treatments (Chronis, Jones, & Raggi, 2006; Hoza, Johnston, Pillow, & Ascough, 2006; La Greca, Silverman, & Lochman, 2009; but see also Lavigne et al., 2008; Leijten et al., 2018; Lundahl et al., 2006; Rieppi et al., 2002).

Susceptibility to behavioral treatments could also depend on severity of a child's problem behavior at baseline. Superior treatment effects are found for children with more severe behavioral problems compared to children with less severe symptomology (Kolko, Cheng, Campo, & Kelleher, 2011; Lavigne et al., 2008; Leijten et al., 2018; Lundahl et al., 2006; Reyno & McGrath, 2006; Thijssen et al., 2017), although other studies report worse treatment effects for children with more severe behavioral problems (Owens et al., 2003; Van Lier et al., 2004). More room for improvement would explain why larger effects were observed in children with more severe problem behavior. However, a low-intensive behavioral self-help program such as the PR program might not be sufficient to target the specific needs of children with severe and persistent dysfunction (van den Hoofdakker et al., 2010).

Investigating the moderating effect of social functioning might also prove fruitful. Literature showed limited effects of a behavioral program for children with both behavioral and social problems (Spilt, Koot, & van Lier, 2013). This seems plausible as the difficulties faced by these children might be more severe and persistent. Moreover, the perceived efficacy of teachers targeting problem behavior in children with both behavioral and social problems could be lower than the effects on children who only experience behavioral problems. Children

with adequate social functioning might be more open to the introduction of new behavioral strategies in the classroom and could thus be more responsive to behavioral interventions which focus on reinforcing positive behavior.

Since children with ADHD have high rates of comorbid problem behavior such as conduct problems and internalizing behavior (Angold, Costello, & Erkanli, 1999), it is important to know whether comorbid problem behavior moderates the effectiveness of our teacher program. In general, studies investigating comorbidities suggest no moderating effect of comorbid ODD/CD on the effectiveness of behavioral programs (MTA Cooperative Group, 1999; Pelham & Fabiano, 2008). Other studies, however, do suggest more treatment gains for children with ADHD and high levels of internalizing problems (March et al., 2000; van den Hoofdakker et al., 2010; Van der Oord, Prins, Oosterlaan, & Emmelkamp, 2008a). Hence, differential treatment response could depend on the existence of comorbid problem behavior. Given the low intensity of the PR program, the program might be less effective for children with comorbid problem behavior who often have more functional impairments and worse long-term prognoses than children with ADHD only (Bauermeister et al., 2007; Biederman et al., 1996; Connor et al., 2003).

Finally, classroom variables such as teaching experience and class size are considered as relevant moderators. Experienced teachers are generally more confident in managing ADHD in the classroom (Reid, Vasa, Maag, & Wright, 1994), and increased teacher self-efficacy is positively related to performance (Schunk, 1984). Therefore, experienced teachers might apply behavioral and classroom management strategies more effectively in their classroom and superior treatment effects may thus be expected. Class size could also differentially affect the efficacy of behavioral interventions because teachers perceive class size to be a barrier for managing ADHD in the classroom (Mulligan, 2001; Reid et al., 1994). In smaller classes, students receive more individual attention from the teacher and students are less likely to be distracted or disrupted by other children (Blatchford, Bassett, & Brown, 2011). The personalized approach in smaller classes might be crucial during behavioral interventions for children with ADHD.

To summarize, the current study investigated the moderating effects of diverse child characteristics and classroom variables on the beneficial effects of an 18-week self-help behavioral teacher program on teacher-rated ADHD symptoms and social skills. Based on the low intensity of the PR program, we hypothesized

superior treatment effects for children with highly educated parents and for children with relatively less severe symptomology and no comorbid problem behavior. No predictions were made regarding age and gender given the highly inconsistent literature. Furthermore, children with well-developed social skills were also expected to benefit more from the PR program. Finally, it was hypothesized that more teaching experience and smaller classes would foster the program's effectiveness.

METHODS

Participants

The study sample (N = 114) comprised primary school children (6-13 years) who displayed high levels of ADHD symptoms in the classroom and took part in an earlier study assessing the effectiveness of the PR program (Veenman et al., 2016). Participants were randomly assigned at school level to the intervention group (n = 58; 91% male) receiving the PR program (44 classrooms of 30 schools), or the waitlist control group (n = 56 from 43 classrooms of 34 schools; 77% male) that could receive care as usual (22% received some form of care, such as advice from a school counselor or parent training). Teachers of the participants in the waitlist control group received the PR program after having participated in this study.

Inclusion criteria were (a) high levels of teacher-rated ADHD symptoms (> 90th percentile) based on the Hyperactivity/Impulsivity and/or Inattention scale of the Disruptive Behavior Disorders Rating Scale (DBDRS, Teacher version; Oosterlaan et al., 2008; Pelham et al., 1992), and (b) at least three clinical and three subthreshold ADHD symptoms on the Teacher Telephone Interview (TTI; Holmes et al., 2004), a semi-structured interview based on Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 2000). Exclusion criteria were (a) treatment for ADHD (including medication) at study entry or in the preceding six months; (b) enrollment in a daily contingency management program or another teacher program addressing behavior or social problems at study entry or in the preceding month; (c) IQ < 80 estimated using a short version of the third edition of the Wechsler Intelligence Scale for Children (WISC-III, including Block Design and Vocabulary; Sattler, 1992), or (d) a neurological or severe physical condition interfering with daily functioning. No more than two children per classroom and five classrooms per school were allowed to participate in order to limit the burden for teachers and to increase heterogeneity of teacher and school settings (Scherbaum & Ferreter, 2009). The participants' flowchart can be found in the earlier study of Veenman

and colleagues (2016) and reveals very low drop-out rates (3% in the intervention group and 0% in the control group, $\chi^2 = 1.97$, $p = .16$). Demographic characteristics and outcomes on screening measures are displayed in Table 1.

Positivity & Rules Program

The PR program consists of a self-help behavioral teacher program addressing ADHD symptoms in the classroom, involving a teacher manual without additional expert training (for a more detailed description of the PR program, see Veenman et al., 2016). The program involves elements of effective behavioral teacher programs (e.g., the classroom component of the Summer Treatment Program; MTA Cooperative Group, 1999) such as psycho-education for the teacher, classroom behavior management strategies (e.g., physical adjustments within the classroom, effective instructions), and contingency management (e.g., reward and time-out system; Chronis, Chacko, Fabiano, Wymbs, & Pelham Jr, 2004). These program elements are implemented by the teachers themselves in their classrooms. During the 18-week program students with ADHD symptoms and their classmates are administered a universal program encompassing basic behavior strategies used throughout the entire day (e.g., positively formulated rules, effective instructions and a reward system). Although several techniques will be familiar to most teachers, the manual instructs teachers on how to systematically and adequately implement all intervention elements by providing detailed practical instructions on implementation. In addition, the PR program contains an individual program for students with ADHD symptoms, involving a Daily Report Card (DRC) to reward children for achieving specific behavioral goals. The individual program consists of three intensity levels, differing in the number of times per day behavioral goals are evaluated and rewards are provided. Practical examples (e.g. examples of non-material rewards), work sheets (e.g. Daily Report Card), and flow diagrams (e.g. of the Time-out System) are included in the manual to facilitate program implementation.

Implementation Fidelity

Teachers reported to have used all elements of the universal program at least 85% of the time during the 18 intervention weeks ($M = 0.88\%$; $SD = 0.11$), with the single exception of the element 'provide the child with three compliments after a reprimand is given' which was used on average 61% of the time ($SD = 0.37$). Most teachers (81%) reported adequate or good implementation of the universal reward system during the entire intervention, with the remaining 19% reporting inadequate implementation in one or two weeks during the course of the entire

	Intervention Group (n = 58)	Control Group (n = 56)
Demographic Characteristics		
Age (Years)	8.48 (1.85)	8.25 (1.97)
Gender (% Male)*	91% (n = 53)	77% (n = 43)
IQ	104.02 (11.34)	100.21 (10.41)
Parental educational level	3.37 (0.67)	3.24 (0.95)
Race (% Caucasian)	86% (n = 50)	82% (n = 46)
ADHD Diagnosis	10% (n = 6)	9% (n = 5)
Other Psychiatric Diagnosis	2% (n = 1; CD)	2% (n = 1; PDD-NOS)
Parent DBDRS		
Inattention	11.71 (5.23)	10.77 (5.57)
Hyperactivity/Impulsivity	11.79 (5.42)	10.47 (5.49)
ODD	5.88 (3.84)	4.93 (4.00)
CD	0.86 (1.31)	0.90 (1.40)
Teacher DBDRS		
Inattention	14.63 (5.26)	14.90 (5.83)
Hyperactivity/Impulsivity	15.67 (5.35)	15.03 (6.23)
ODD	6.77 (4.75)	5.95 (4.75)
CD	1.43 (1.65)	1.57 (1.90)
TTI		
Inattention	12.50 (6.12)	12.45 (5.34)
Hyperactivity/Impulsivity*	15.62 (6.03)	12.88 (5.78)
Combined	28.12 (8.97)	25.33 (8.34)
Outcome Measures at Baseline		
ADHD Symptoms (SWAN)	1.40 (0.75)	1.32 (0.68)
ADHD Symptoms (SDQ ADHD)	8.26 (1.59)	7.41 (1.89)
Social Skills (SSRS)	29.81 (9.89)	32.17 (7.96)

Table 1. Characteristics of participants (N = 114) in intervention and control group

Note. *M* and *SD*s are depicted unless stated otherwise.
ADHD = Attention-Deficit Hyperactivity Disorder;
CD = Conduct Disorder;
DBDRS = Disruptive Behavior Disorder Rating Scale;
ODD = Oppositional Defiant Disorder;
PDD-NOS = Pervasive Developmental Disorder-Not Otherwise Specified;
SDQ ADHD = ADHD scale of the Strengths and Difficulties Questionnaire;
SSRS = Social Skills Rating Scale;
SWAN = Strengths and Weaknesses of ADHD-symptoms and Normal-behavior scale;
TTI = Teacher Telephone Interview
(Adapted with permission of SAGE publishing from Veenman, Luman, & Oosterlaan, 2016).
* $p < .05$

18 weeks. Teachers reported to have used all elements of the Daily Report Card adequately for most of the 18 weeks (M = 0.78% of the time; SD = 0.23). Only 15% of the teachers consulted the helpdesk during study participation.

Outcome measures

ADHD symptoms were assessed with the Strengths and Weaknesses of ADHD-symptoms and Normal-behavior scale (SWAN, teacher version; Swanson et al., 2006) and the ADHD scale of the Strengths and Difficulties Questionnaire (SDQ, teacher version; Van Widenfelt et al., 2003). The SWAN is an 18-item rating scale measuring the presence and severity of ADHD symptoms on a continuum. This questionnaire consists of a Hyperactive/Impulsive, Inattentive, and Combined scale. The average item score on the Combined scale was used as outcome measure. Items are rated on a 7-point Likert scale from -3 (far above average) to +3 (far below average). In the current study, items were reverse scored so that higher scores indicated more ADHD symptoms. The SWAN has high internal reliability (0.94-0.96) and validly assesses ADHD symptoms (Lubke et al., 2007; Young et al., 2009). The ADHD scale of the SDQ consists of five items and measures ADHD symptoms on a 3-point Likert scale (0 = not true, 1 = somewhat true and 2 = certainly true), using the total score as outcome measure. The composite reliability of the SDQ ADHD scale is high (0.94-0.96), as well as the average variance extracted (0.77-0.82; Niclasen, Skovgaard, Andersen, Sømhovd, & Obel, 2013). The internal consistency of the SDQ ADHD scale (Dutch version) is also good (α = 0.89) and the concurrent validity is adequate (r = 0.78; Van Widenfelt et al., 2003).

To assess the child's social skills, the Social Skills Rating Scale (SSRS, teacher version) was administered (Gresham & Elliott, 1990). The SSRS consists of 30 items divided over three subscales (Collaboration, Assertiveness and Self-Control). Items are rated on a 3-point Likert scale (0 = never, 1 = sometimes and 2 = often) and the total score was used as outcome measure. Adequate internal consistency and high predictive validity have been reported for the SSRS (κ = 0.77; Van der Oord et al., 2005).

Moderator variables

Moderator variables were measured prior to the start of the intervention to assess which factors moderated the effectiveness of the PR program.

Demographic characteristics

The demographic characteristics used as moderators in the current study were

age (in years), gender (using boys as reference group), and parental educational level. Parental educational level was measured as the average of both parents' educational level using an adapted version of the Dutch educational classification system (1 = primary education, 2 = secondary vocational education, 3 = secondary general education, 4 = undergraduate school, 5 = graduate school; Verhage, 1983).

Severity of Problem Behavior

Severity of ADHD symptoms at baseline was measured using the SWAN (see Outcome Measures) and severity of conduct problems and internalizing problems at baseline was assessed with the SDQ (measuring conduct problems with the Conduct scale, and internalizing problems as the sum of the Emotional and Peer Problems scale). Each SDQ scale (Van Widenfelt et al., 2003) consists of five items on a 3-point Likert scale (0 = not true, 1 = somewhat true and 2 = certainly true). The internal consistency of the scales is adequate ($0.74 < \alpha < 0.76$), as well as the composite reliability (0.88-0.96) and average variance extracted (0.73-0.85; Niclasen et al., 2013). Self-reported anxiety at baseline was measured using the Spence Children's Anxiety Scale (SCAS; Spence, 1997). The SCAS consists of 44 items, which are scored on a 4-point Likert scale (0 = never, 1 = sometimes, 2 = often, and 3 = always). The total score was used as moderator variable. The reliability of the SCAS is high (Cronbach's $\alpha = 0.92$ and McDonald's omega = 0.95) and validity is also well established (Nauta et al., 2004; Spence, 1998).

Social Functioning

The moderators related to social functioning were teacher-reported social skills as measured by the SSRS (see Outcome Measures) and peer acceptance. Peer acceptance was measured through peer ratings, in which participants and their classmates were asked to indicate how much they liked each classmate on a 5-point rating scale (1 = dislike very much, 3 = neutral, 5 = like very much; Hoza, Mrug, et al., 2005). Adequate reliability and validity have been reported for peer ratings ($r = 0.47$ and $r = 0.44$; Olsen, Draper, Wu, & Hart, 2001). Social preference was used as indication of peer acceptance and was calculated following the procedure of Maassen and colleagues (Maassen, Akkermans, & Van Der Linden, 1996; Maassen et al., 2000).

Comorbid problem behavior

Moderating effects of comorbid problem behaviors (conduct problems, internalizing problems, anxiety problems and limited social skills) were assessed using the same instruments as described above. Hence, the SDQ (teacher

version) was used to measure conduct problems and internalizing problems, the SCAS to measure self-reported anxiety and the Teacher SSRS and peer ratings were used to measure social skills.

Classroom variables

The moderating classroom variables used in the current study were teaching experience (in years) and class size (i.e., the number of students in each class).

Procedure

This study was conducted in the Netherlands between September 2011 and July 2014. Teachers and parents were recruited through educational consultant associations, the national parent association for children with developmental problems, and the study's website. In case teachers were interested in participating, they enlisted one or two students displaying ADHD symptoms in their classroom. Written informed consent was obtained from all parents, teachers, and participants older than 11 years. Participants were screened for eligibility by the first author BV. ML, who had not been in contact with any participants, was responsible for the subsequent computer-generated randomization to allocate children to the intervention or control group. Teachers were aware of treatment allocation given their involvement in treatment delivery. Parents and children were also aware of treatment allocation, as they were aware of the obvious classroom changes (e.g., the rewarding system for the entire classroom and the use of the Daily Report Card). Although the universal program was used in the entire classroom, only children displaying ADHD symptoms in the classroom were included as participants in this study. Dependent variables were measured at three specific points in time: at baseline (T_0), 6 weeks after start of the PR program (T_1), and after 18 weeks at the end of the intervention (T_2). For the children in the intervention group, the SWAN was also administered in week 9, 12, and 15 after the start of the intervention to monitor progress and to adjust the intensity level of the individual program (see Veenman et al., 2016). For all moderating variables, baseline scores were used. All participating teachers received a small financial compensation (control group: € 50; intervention group: € 125). This study was carried out in accordance with the recommendations of the medical ethical committee of the Vrije Universiteit Amsterdam with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the medical ethical committee of the Vrije Universiteit Amsterdam (reference number 2011/196).

Statistical analyses

To assess which factors moderate the effectiveness of the PR program, multilevel regression analyses were conducted using the Statistical Package for the Social Sciences (SPSS; IBM Corp, 2011). All randomized subjects participated in the intention-to-treat analyses, regardless of the amount of missing data. For all measures, the percentage of missing data was low (3.6% for the SWAN; 2.6% for the SCAS, and 1.8% for the SDQ, SSRS and Peer Rating). Missing data were not imputed as multilevel analyses adequately deal with missing data (Twisk, de Boer, de Vente, & Heymans, 2013).

Four hierarchical levels were used: observations (level 1) were nested within students (level 2), students were nested within classrooms (level 3), and classrooms were nested within schools (level 4; Heck et al., 2013). First, the overall intervention effects on ADHD symptoms (measured by the SWAN and SDQ ADHD scale) and social skills (measured by the SSRS) were estimated by using Group as dichotomous independent variable, while controlling for baseline levels of the dependent variable. Subsequently, separate multilevel regression analyses were conducted to assess the moderating effects of the demographic characteristics (gender, age, and parental educational level), severity of problem behavior (ADHD symptoms, conduct problems, internalizing problems, and anxiety), social functioning (teacher-reported social skills and peer acceptance), and classroom variables (teaching experience and class size). This was done by centering all moderators (except for gender) first, after which the moderator and interaction between group and moderator were added to the original model that consisted of Group and baseline level of the dependent variable.

The moderating effects of comorbid problem behaviors (conduct problems, internalizing problems, anxiety problems, and social skills) were assessed by looking at three-way interactions between group and all possible pairs of comorbid problem behaviors (e.g., group x ADHD symptoms x conduct problems; group x ADHD symptoms x anxiety symptoms; etcetera). Similar three-way interactions were used to assess whether the level of social skills in combination with other problem behaviors (ADHD symptoms, conduct problems, internalizing problems, and anxiety) moderated treatment gains on social skills. In case of significant three-way interactions, post-hoc analyses were performed to assess treatment effects for four different groups, using a median-split for both variables (e.g., anxiety and ADHD symptoms). If an interaction involved the SWAN ADHD scale (measuring ADHD symptoms), the terms

'relatively high' and 'relatively low' levels of ADHD symptoms were used to describe children scoring at one of the extreme ends of the ADHD continuum. Alpha-level was set at .05.

RESULTS

Results of the multilevel regression analyses, assessing which moderators influenced the effectiveness of the PR program, are displayed in Table 2. The three-way interactions assessing the moderating effects of the program are not displayed in Table 2, but significant three-way interactions are visualized in Figure 1 and 2.

Table 2. Results moderation multilevel analyses

	SWAN ADHD		SDQ ADHD		Social Skills	
Moderating Effects	Coefficient (*SE*)	*p*-value	Coefficient (*SE*)	*p*-value	Coefficient (*SE*)	*p*-value
Demographic Characteristics						
Age	-0.12 (0.05)	.036*	-0.14 (0.19)	.459	0.95 (0.60)	.119
Gender	-0.16 (0.25)	.528	-0.31 (0.97)	.749	-0.84 (2.97)	.779
Parental educational level	-0.37 (0.10)	<.001**	-0.45 (0.44)	.844	2.35 (1.31)	.076
Severity of Problem Behavior at Baseline						
ADHD Symptoms (T)	0.12 (0.13)	.341	-0.08 (0.19)	.664	-	-
Conduct Problems (T)	0.03 (0.05)	.472	0.00 (0.17)	.981	-	-
Internalizing Problems (T)	0.02 (0.03)	.456	-0.04 (0.11)	.730	-	-
Anxiety (Self-Report)	0.009 (0.006)	.138	0.00 (0.03)	.929	-	-
Social Functioning at Baseline						
Social skills (T)	-	-	-	-	-0.09 (0.11)	.426
Peer Acceptance	-	-	-	-	-2.47 (0.87)	.005**
Classroom Variables						
Experience Teacher	0.01 (0.01)	.186	0.03 (0.04)	.430	-0.16 (0.10)	.117
Class Size	-0.02 (0.03)	.499	-0.08 (0.09)	.362	0.16 (0.28)	.567

Note. Tabulated effects on teacher-rated ADHD symptoms (SWAN and SDQ ADHD) and social skills pertain to interactions between the moderator of interest and group (intervention group versus control group). The other fixed effects and all random effects are not displayed in this table but can be obtained upon request. Lower scores on the SWAN and SDQ ADHD indicate improvement (i.e., reduction) of ADHD symptoms. Higher scores on social skills indicate improvement (i.e., increase) of social skills. SDQ = Strengths and Difficulties Questionnaire; SWAN = Strengths and Weaknesses of ADHD-symptoms and Normal Behavior. T = teacher rating. * $p < .05$. ** $p < .01$.

Moderators for intervention effects on ADHD symptoms

Before assessing which moderators influenced the effects of the PR program on ADHD symptoms as measured by the SWAN and the SDQ ADHD scale, primary analyses confirmed positive intervention effects on ADHD symptoms when controlling for baseline ADHD symptoms (*b(SE)* = -0.50(0.11), $p < .001$ for the SWAN and *b(SE)* = -0.87(0.35), $p = .017$ for the SDQ ADHD). Regarding the SWAN, moderating effects were found for Age and Parental educational level, indicating that the intervention effect on ADHD symptoms was more beneficial for older compared to younger children (*b(SE)* = -0.12(0.05), $p = .036$) and for children from highly educated families compared to lower educated families (*b(SE)* = -0.37(0.10), $p < .001$). No significant moderating effects were found for any of the other variables on ADHD symptoms as measured by the SWAN.

Results on the SDQ ADHD did not reveal any significant moderating effects for Age or Parental educational level. The SDQ results did reveal a significant moderating effect for comorbid anxiety problems, suggesting smaller program effects for children with high levels of both ADHD symptoms and self-reported anxiety (*b(SE)* = 0.04(0.02), $p = .014$). To illustrate this interaction, post-hoc analyses were conducted to assess treatment effects for four different groups (relatively low ADHD symptoms and low anxiety, relatively high ADHD symptoms and high anxiety, or one of the two variables high and the other variable low). Results of these post-hoc analyses (see Figure 1) suggest that children with relatively high levels of ADHD symptoms (> 7 on the SDQ ADHD scale that ranged from 0 to 10) and high levels of anxiety problems (> 18 on the SCAS that ranged from 1 to 78) did not profit from the PR program in terms of ADHD symptoms (*b(SE)* = 0.34(0.63), $p = .603$). Significant treatment gains were found for children with relatively high levels of ADHD symptoms but low levels of anxiety (*b(SE)*=-1.52(0.56), $p = .013$), meaning a reduction of almost one standard deviation on the SDQ ADHD scale ($M = 7.85$; $SD = 1.79$). No significant treatment effects were found for the other two groups (children scoring relatively low on ADHD symptoms but high on anxiety, $p = .063$, and children scoring low on both variables, $p = .597$). No other significant moderating effects were found on ADHD symptoms as measured by the SDQ ADHD.

Moderators for intervention effects on social skills

Before assessing the moderating effects on social skills, primary analyses confirmed that social skills of children in the intervention group significantly improved compared to those of children in the control group when controlling

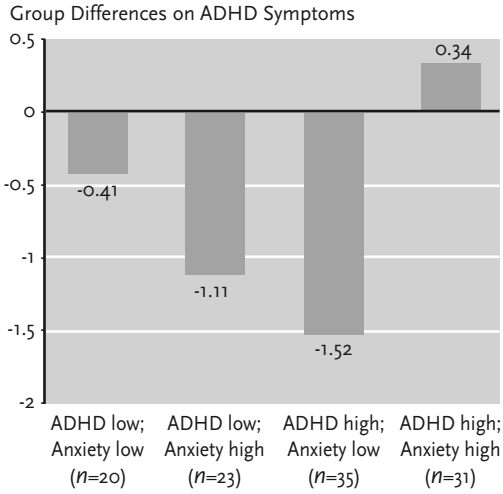

Figure 1. Differences between intervention and control group on ADHD symptoms (measured with SDQ ADHD scale) for four groups of children differing in level of ADHD symptoms (median split SDQ ADHD: score > 7 indicates high levels of ADHD symptoms) and anxiety problems (median split SCAS: score > 18 indicates high levels of anxiety problems). Results demonstrate a significant reduction of ADHD symptoms in intervention children scoring high on ADHD symptoms and low on anxiety (p = .013), compared to children in the control group. No significant group differences were found for children scoring high on both moderators or low on both moderators (p = .603 and p = .597, respectively), nor for children scoring relatively low on ADHD symptoms but high on anxiety (p = .063).

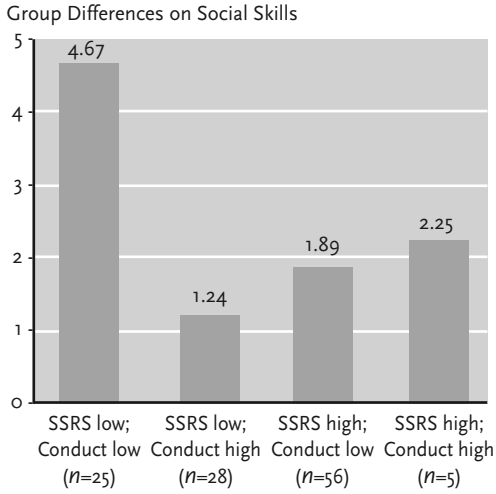

Figure 2. Differences between intervention and control group on social skills (measured with SSRS) for four groups of children differing in level of social functioning (median split SSRS: score > 31 indicates high levels of social functioning) and conduct problems (median split SDQ: score > 1 indicates high levels of conduct problems). SSRS = Social Skills Rating Scale. Results demonstrate largest treatment gains for children scoring low on both social skills and conduct problems (p = .018) compared to the other groups where no significant differences were found (p-values > .26).

for baseline social skills ($b(SE)$ = 3.26(1.26), p = .003). Results revealed a significant moderating effect for peer acceptance ($b(SE)$ = -2.47(0.87), p = .005), indicating that the intervention was more effective for children who were less accepted by peers at baseline. Furthermore, results also showed a higher effectiveness of the PR program for children with low levels of both conduct problems and teacher-rated social skills ($b(SE)$ = 0.16(0.06), p = .014). This finding was confirmed by post-hoc analyses assessing treatment effects for four different groups (low SSRS and low conduct, high SSRS and high conduct, or

one of the two variables high and the other low) by dichotomizing both variables through median split (> 31 for the SSRS and > 1 for the SDQ Conduct scale). Post-hoc results showed largest treatment gains for children scoring low on both social skills and conduct problems ($b(SE)$ = 4.67(1.85), p = .018) compared to the other groups (p-values > .26; see Figure 2). This gain for children scoring low on both social skills and conduct problems indicated that social skills of these children improved approximately half of one standard deviation on the SSRS (M = 30.95; SD = 9.07). No other significant moderating effects were found on social skills.

DISCUSSION

This study aimed to investigate which child and classroom variables moderated the effects on teacher-rated ADHD symptoms and social functioning of the PR program, a behavioral teacher program targeting ADHD symptoms in the classroom. Significant moderating effects were found for age and parental educational level on ADHD symptoms (as measured by the SWAN), indicating that the effect of the PR program on ADHD symptoms was larger for older children and for children from highly educated families. Results on the SDQ ADHD measure suggest larger treatment gains for children with both high levels of ADHD symptoms and low levels of anxiety, while program effects appeared absent for children with high levels of both ADHD symptoms and anxiety. The effects of the PR program on social functioning was significantly moderated by peer acceptance, indicating that the intervention was more effective for children who were less accepted by peers at baseline, and by the interaction between social skills and conduct problems, indicating superior program effects for children who scored low on social functioning and did not have serious conduct problems.

This study isolated what type of children would benefit most from our self-help behavioral teacher program. Results show that our intervention might be more effective for older children, for children from highly educated families, and for children with high levels of ADHD symptoms in the absence of other problem behavior (i.e., conduct problems or anxiety). These findings are in line with our hypothesis that this low-intensive behavioral teacher program could be more effective for children from highly educated families, and those without comorbid psychopathologies. For children from low-educated families and for those with severe comorbid problem behavior, more intensive therapeutic support might be needed to successfully reduce ADHD symptoms and improve social functioning (van den Hoofdakker et al., 2010).

Regarding the moderating role of age, our results are in line with (meta-analytic) evidence that also revealed larger effects of behavioral programs for older children (Comer et al., 2013; van den Hoofdakker et al., 2010), although there is also meta-analytic evidence revealing no moderating effects of age (Lundahl et al., 2006). Perhaps, older children can more easily inhibit their impulses and comply with the challenges imposed by teachers implementing the PR program than younger children, because brain development and socialization improves with age (Faraone, Biederman, & Mick, 2006).

The absence of a moderating effect of gender is in line with the MTA study where gender did not moderate treatment outcomes either (MTA Cooperative Group, 1999) and suggests that the PR program is equally effective for boys and girls. However, it could also be that no moderating gender effect was found due to the high percentage of boys participating in our study (84%), resulting in limited power to detect gender differences. Indeed, moderating effects of gender have been found in other studies where roughly half of all participants were girls (see for example Lavigne et al., 2008; Witvliet et al., 2009). More research on samples with a more equal gender distribution is necessary to confirm whether the PR program is equally effective for both boys and girls.

Our finding that the PR program is more effective for children from highly educated parents is in line with several reviews discussing predictors and moderators of treatment outcomes in children with ADHD (Chronis et al., 2006; Hoza et al., 2006). In most of those treatments, however, parents were involved in treatment delivery (e.g., medication and parent programs), in which case the moderating role of parental educational level could be explained by greater involvement and greater treatment adherence of highly educated parents (La Greca et al., 2009). This explanation is less likely in our study where parents were not involved in treatment delivery. A more likely explanation might be related to teachers' attitudes and expectations. Children from families with a low socioeconomic status (SES, often quantified by parental education) are often perceived less positively by teachers and teachers have lower expectations of these children in terms of academic and behavioral functioning (McLoyd, 1998). Hence, it is possible that teachers also expect less treatment improvement in these children.

The current results indicate that the PR program is equally effective for all children with ADHD symptoms, regardless of the severity of their ADHD symptoms, which is in line with meta-analytic evidence (Lundahl et al., 2006;

Reyno & McGrath, 2006). However, children with comorbid conduct or anxiety symptoms do seem to profit less from this program. More specifically, no treatment gains on ADHD symptoms were found for anxious children with high levels of ADHD symptoms, while large improvements on ADHD symptoms were found for non-anxious children with high levels of ADHD symptoms. The reason that others did find larger treatment gains for behavioral programs in children with ADHD and comorbid anxiety (March et al., 2000; van den Hoofdakker et al., 2010; Van der Oord et al., 2008a) could be related to the larger involvement of parents in these programs. Parents of children with ADHD and comorbid anxiety symptoms could be more anxious and overprotective towards their child than parents of children without comorbid anxiety symptoms (Pfiffner & McBurnett, 2006) and might thus be more inclined to conform to treatment protocols (Van der Oord et al., 2008a), possibly resulting in larger treatment gains. In this manualized teacher program, parents were not involved in treatment delivery at all, which could explain the different results of this study. Perhaps, the perceptions of teachers can explain the lower gains of the PR program for anxious participants. Anxious children are likely to show very intense help-seeking and proximity-seeking behaviors towards teachers, which could result in teachers perceiving the child as challenging and this could in turn cause frustration (Pianta & Nimetz, 1991), thus impeding treatment gains. Providing teachers with more elaborate information on comorbid internalizing and externalizing problems in children with ADHD and additional therapeutic support might help to increase the effectiveness of the PR program (Gillberg et al., 2004).

For children scoring low on social functioning the PR program appears to be more effective in improving teacher-rated social skills, particularly if conduct problems are absent or not very severe. Possibly, children with limited social skills who do not display oppositional or aggressive behavior (e.g. children who are shy or withdrawn) have more room to improve their social functioning thanks to enhanced classroom structure and positive reinforcement provided by the PR program. In contrast, children with both limited social skills and conduct problems might be more likely to oppose the changes made in the classroom during the implementation of the PR program, which could thus result in smaller benefits for those children.

The current findings need to be interpreted in light of the following limitations. First, power was somewhat limited due to the relatively small sample size, urging cautious interpretation of the current findings. Second, our sample

mainly comprised boys, limiting the reliability of the finding that the PR program would be equally effective for boys and girls. This problem is common in ADHD research though, since boys are clearly overrepresented in the diagnosed ADHD population (Gershon & Gershon, 2002). Third, we acknowledge that we did not assess the influence of other potentially interesting variables on treatment outcome, such as problems at home (e.g. maternal depression or marital problems) or several teacher variables (e.g. teachers' treatment expectations, treatment acceptance, and compliance). Fourth, this study did not investigate the influence of non-specific treatment effects on treatment outcomes such as positive treatment expectations. Future research is thus necessary to distinguish specific from non-specific treatment effects.

Conclusion

This study investigated the moderating effects of several child and classroom variables on the effectiveness of a low-intensive behavioral teacher program (PR program) in children with ADHD symptoms. Results indicated that the PR program could be more effective for older children and for children from highly educated families, while comorbid conduct or anxiety problems in combination with high levels of ADHD symptoms appeared to impede treatment gains. Hence, it appears that this self-help teacher program is suitable for children not facing additional challenges but may not be able to address the needs of children from low-educated families and those with comorbid psychopathology.
The current findings underline the importance of using the PR program in a preemptive stage before behavioral problems escalate or transfer to multiple domains.

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CHAPTER 6 Understanding Peer Problems of Inattentive and Hyperactive-Impulsive Children

ABSTRACT

Objective

This study aimed to gain more insight into peer problems of children with symptoms of attention-deficit hyperactivity disorder (ADHD).

Methods

Participants were 111 Dutch primary school children with high levels of classroom ADHD symptoms (84% boys) and their 2,526 classmates serving as controls. Peer ratings and peer nominations were used to measure diverse aspects of peer relations such as social preference, number of dyadic friendships and level of imbalance, reflecting the difference between ratings made and received by a child. Scores were standardized within classrooms using sociometric data of participants' classmates. Multilevel analyses were conducted to assess whether teacher-rated inattention, hyperactivity/impulsivity, conduct problems, emotional problems and prosocial behavior were associated with the peer problems.

Results

Children with ADHD symptoms experienced many peer problems (d = 0.25-0.61), with profound impairments in terms of social preference, number of classmates nominating participants as non-friend, and negative imbalance (d = 0.49-0.61). Inattention, hyperactivity/impulsivity and conduct problems were related to peer problems, with generally stronger effects in younger children. Finally, results suggest that children with ADHD symptoms associate with other disliked peers when growing older.

Conclusion

Given the substantial peer problems of children with ADHD symptoms, interventions targeting peer problems should not be restricted to children with clinical ADHD.

INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is the most common pediatric behavioral disorder, occurring in approximately 5% of all school-aged children and crucially interferes with daily functioning (Polanczyk et al., 2007). Besides hyperactivity/impulsivity and inattention, children with ADHD commonly exhibit comorbid problems such as antisocial behavior, learning disabilities, emotional and social problems (Hong et al., 2014; Wilens et al., 2002). The social problems of these children emerge, among others, in peer problems such as peer rejection and difficulty maintaining friendships (Hoza, 2007). Both ADHD and peer problems have been associated with future adjustment problems (Parker, Rubin, Erath, Wojslawowicz, & Buskirk, 2006) and having ADHD symptoms in combination with peer problems further increases the risk of adverse outcomes later in life (Mikami & Hinshaw, 2006).

Understanding peer relations is complex and involves understanding the influence of both proximate (peers) and distant ecological systems (e.g., teachers, family; Rodkin, Gest, Espelage, & Swearer, 2011). Regarding the influence of peers, an important distinction is that between the vertical dimension of social status and the horizontal dimension of social networks (Rodkin et al., 2011). Social status relates to unequal, dominant relationships among peers such as popularity. The presence of status hierarchies within a classroom can influence group norms, with aggression being more popular in hierarchical classrooms than in more egalitarian classrooms, where group norms favor prosocial behavior (Ahn, Garandeau, & Rodkin, 2010). The horizontal dimension of social networks relates to patterns of positive and negative peer relationships such as friendships and mutual dislike. The degree to which there are subgroups of children that form separate social networks, and the dominant behaviors of these subgroups, can affect the behavior of individual members such as aggressive or deviant behavior (Ellis & Zarbatany, 2007). Hence, to fully comprehend children's peer problems, a comprehensive view of both vertical and horizontal dimensions of their peer relations is essential.

Despite the extensive literature associating ADHD with peer problems, there are relatively few studies using sociometric measures. Sociometric measures are considered to be the gold standard to study social functioning at school, because these measures rely on reports of multiple peers who have access to unmonitored situations inaccessible to parents and teachers (Bukowski, Cillessen, & Velasquez, 2012). However, existing sociometric studies involving children with ADHD provide a limited picture of the child's social functioning.

Most studies have mainly focused on one or two peer measures, such as the vertical dimensions peer acceptance, peer rejection, social preference and social impact (Bellanti & Bierman, 2000; Blachman & Hinshaw, 2002; Hinshaw, 2002; Hodgens, Cole, & Boldizar, 2000). Literature consistently indicates that children with ADHD are less accepted by peers, more often rejected, and that they have a lower social preference and a higher social impact (i.e., visibility among peers; Diamantopoulou et al., 2007; Hoza, 2007). Relatively less attention has been paid to horizontal dimensions of peer relations in ADHD, such as dyadic friendships, characteristics of nominated and nominating peers, and level of imbalance, which reflects the difference between the liking ratings made and received by a child.

Regarding the horizontal dimensions investigated in ADHD, most attention has been paid to dyadic friendships. Dyadic friendships imply a close, reciprocal friendship based on cooperation and trust that contributes to the child's social-emotional development and future adjustment (Gifford-Smith & Brownell, 2003). While peer rejection by the larger peer group is found to predict poor overall life adjustment (e.g., poor school and job performance, poor social life, mental health problems, criminality), having a reciprocal friend predicts self-worth and can reduce the risk of peer victimization (Bagwell, Newcomb, & Bukowski, 1998; Cardoos & Hinshaw, 2011; Hoza, Bukowski, & Beery, 2000). The three studies that have assessed dyadic friendships in children with ADHD, indicate that these children have fewer friendships than controls and are twice as likely to lack even a single dyadic friendship (Blachman & Hinshaw, 2002; Cardoos & Hinshaw, 2011; Hoza, Mrug et al., 2005). One (older) study using a nonclinical sample showed that hyperactive boys have fewer dyadic friendships than typically developing active boys (King & Young, 1981).

Other horizontal dimensions have rarely been investigated in ADHD through sociometry, such as the sociometric scores of the nominating and nominated peers (i.e., peers who choose and are chosen by children with ADHD as friends and non-friends, respectively). Disliked peers with ADHD tend to associate with other disliked, deviant peers, and having deviant peers increases the risk of adverse long-term effects such as substance abuse (Dishion, Capaldi, Spracklen, & Li, 1995; Mariano & Harton, 2005; Marton, Wiener, Rogers, & Moore, 2015). Hoza and colleagues (2005) were the first to investigate the popularity of nominating and nominated peers in children with ADHD and showed that children with ADHD were disliked more often by popular children. However, peers whom they nominated as friends were children with normal social

preference, impact and liking scores. As other literature (Mariano & Harton, 2005; Marton et al., 2015) suggest that disliked peers with ADHD seem to associate with other disliked peers, thus increasing the risk for escalation of problem behavior (Dishion et al., 1995), more research on the popularity of nominating and nominated is necessary.

Lastly, Hoza and colleagues were the first to study level of imbalance in ADHD, which reflects the difference between the liking ratings made and received by a child (Hoza, Mrug et al., 2005). Children with ADHD are suggested to have a poor social perception and are likely to overestimate their own likability (Hoza et al., 2000; Marton et al., 2015), which could contribute to the peer problems they encounter. As suggested by Hoza (2005), poor social perception in ADHD may impair "their ability to select others most likely to reciprocate their attempts at liking or friendship initiation". Their results confirmed that children with ADHD show a larger discrepancy between the ratings they give to and receive from other peers (less positive and more negative imbalance). The value of including level of imbalance as peer measure is confirmed by its power to discriminate children with ADHD from their classmates (Mrug et al., 2009).

So far, there are only few studies assessing which aspects of peer problems are related to specific behavioral problems associated with ADHD. Identifying specific behavior problems associated with different aspects of peer problems may be informative for interventions that are set up to enhance peer relationships of children with ADHD. This is of interest, since studies have suggested that inattention and hyperactivity/impulsivity are differentially related to peer problems (Wheeler Maedgen & Carlson, 2000; Zucchetti, Ortega, Scholte, & Rabaglietti, 2015). Children with ADHD combined type, for example, are more likely to be rejected than children with the inattentive type, whereas inattentive children are more passive and socially isolated (Hinshaw, 2002; Hodgens et al., 2000; Wheeler, Maedgen, & Carlson, 2000). Besides ADHD symptoms, conduct problems (e.g. aggression or noncompliance), emotional problems and a lack of prosocial behavior have been associated with peer problems (Diamantopoulou et al., 2007; Mikami, Ransone, & Calhoun, 2011; Mrug, Hoza, Pelham, Gnagy, & Greiner, 2007). A differential effect is also observed for these comorbid behavioral problems: while negative behavior mainly seems to contribute to peer rejection, engaging in prosocial behavior seems more important for peer acceptance (Mrug et al., 2007). Given the limited knowledge on how specific behavior problems associated with ADHD are related to diverse aspects of peer problems, more research is needed on this topic.

Many children with ADHD symptoms not meeting full diagnostic criteria of ADHD experience peer problems (Bellanti & Bierman, 2000; Brendgen, Vitaro, Bukowski, Doyle, & Markiewicz, 2001; Diamantopoulou et al., 2007), conduct problems, learning disabilities, and functional impairments in daily life (Hong et al., 2014). Viewing ADHD as a continuum has, therefore, been argued to do more justice to the variation in severity of ADHD symptoms than the categorical approach neglecting symptom severity. The dimensional approach of ADHD is also supported by several genetic, neuropsychological and behavioral studies, revealing similar but milder deficits in non-clinical ADHD samples compared to clinical ADHD studies (Hay et al., 2004; Polderman et al., 2007; Sonuga-Barke et al., 2002). Hence, using a dimensional approach to investigate peer problems in ADHD might be more fruitful than a categorical approach that merely focuses on children meeting full diagnostic criteria of ADHD. In this study, we did not restrict our sample to clinical ADHD, because we aimed to assess many aspects of peer problems in a more extended group of children with ADHD symptoms experiencing daily impairments. Although peer acceptance, rejection and the number of friends have been investigated extensively in non-clinical ADHD samples, this does not tell the whole story. More insight into the popularity of nominating and nominated peers and level of imbalance of children with ADHD symptoms, will provide a deeper understanding of their peer problems and the types of peers they associate with. This is important, because having rejected peers as friend increases the risk of adverse long-term effects such as substance abuse (Dishion et al., 1995; Mariano & Harton, 2005; Marton et al., 2015).

The main aim of this study was to investigate multiple aspects of peer problems in a Dutch sample of children with high levels of ADHD symptoms, using an elaborate set of peer measures, including social preference and impact, number of dyadic friendships, level of imbalance, and sociometric scores of nominated and nominating peers. Besides that, it was explored whether the separate dimensions of ADHD symptoms (i.e., hyperactivity/impulsivity and inattention), conduct problems, emotional problems and prosocial behavior were related to these peer problems. This study advances on earlier work, including the study by Hoza et al. (2005), in several ways. First, this study uses a Dutch sample, which is unique in this field of research and allows us to investigate cross-cultural differences in peer problems related to ADHD. Second, our participants involved a group of children that experienced high levels of ADHD symptoms at school (not necessarily at home). Most participants involved children without a clinical diagnosis of ADHD whose parents had not sought active treatment so far, resulting in a less clinically impaired sample compared to the MTA study (Hoza,

Gerdes et al., 2005). By expanding our study beyond children meeting full diagnostic ADHD criteria, the range and variability of ADHD symptoms (at home and in school) was larger than in previous clinical studies. This allowed us to also explore in greater detail whether the separate dimensions of ADHD symptoms (i.e., hyperactivity/impulsivity and inattention), and other behavioral problems (conduct problems, emotional problems and low levels of prosocial behavior) were related to peer problems in ADHD.

Based on previous work (Hoza, Mrug et al., 2005), we expected that children with high levels of ADHD symptoms would exhibit impairment on most peer outcomes compared to their classmates. Furthermore, we expected more ADHD symptoms, conduct problems, and emotional problems, and low levels of prosocial behavior to be positively related to peer problems (Diamantopoulou et al., 2007). This study also explored whether age influenced the relations between behavioral problems and peer problems, given the age-dependent decline of behavioral problems (Faraone, Biederman, & Mick, 2006) and age-differences in peer relations (Phillipsen, 1999).

METHODS

Participants

The study sample comprised 111 children (84% boys) in the age of 6 to 13 years (M = 8.89, SD = 1.85) displaying high levels of ADHD symptoms (with or without a diagnosis of ADHD) in the classroom, and 2,526 classmates who served as raters (average participation rate per classroom = 97%). We included children that showed significant and impairing symptoms of ADHD in the classroom. To this end, children with ADHD symptoms were included if they displayed (a) high levels of ADHD symptoms (> 90th percentile) on the teacher-rated Inattention or Hyperactivity/Impulsivity scale of the Disruptive Behavior Disorders Rating Scale (DBDRS, Dutch version; Oosterlaan et al., 2008) and (b) at least three clinical ADHD symptoms and one subclinical symptom as assessed by Teacher Telephone Interview (TTI; Holmes et al., 2004), a semi-structured interview based on Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000). The TTI cut-off criterion of four ADHD symptoms was used because the presence of at least four ADHD symptoms is related to significant psychosocial impairments (Kooij et al., 2005). Children were excluded if they: (a) suffered from a neurological or severe physical condition interfering with daily functioning; (b) had an IQ score lower than 80, estimated using a two-subtest short version of the Wechsler Intelligence Scale for Children-third edition (WISC-III, including Block Design

and Vocabulary; Sattler, 1992), or (c) received any ADHD treatment or behavioral teacher program at study entry or in the preceding month because current sample also participated in a study assessing the effectiveness of a behavioral teacher program. No more than two children per classroom and five classrooms per school were allowed to participate to limit teacher burden and to increase heterogeneity of teacher and school settings involved (Scherbaum & Ferreter, 2009). Sample characteristics are displayed in Table 1. The large majority of our sample (91%) involved children without a clinical diagnosis of ADHD. Participants came from 85 classrooms of 60 regular primary schools.

Table 1. Sample Characteristics of Participants with High Levels of ADHD Symptoms (N=111)

Demographic Characteristics	
Age (years)	8.89 (1.85)
Gender (% male)	84% (*n* = 93)
IQ	102.21 (11.10)
SES[a]	3.32 (0.82)
Race (% Caucasian)	84% (*n* = 93)
ADHD diagnosis	9% (*n* = 10)
Other psychiatric diagnosis	2% (CD: *n* =1; PDD-NOS: *n* =1)
Teacher DBDRS	
Inattention	14.67 (5.53)
Hyperactivity/Impulsivity	15.50 (5.77)
ODD	6.24 (4.77)
CD	1.49 (1.76)
TTI	
Inattention	12.50 (5.79)
Hyperactivity/Impulsivity	14.54 (6.05)
Combined	27.04 (8.83)

Note. *M* and *SD*s are depicted unless stated otherwise.
ADHD = Attention-Deficit Hyperactivity Disorder;
CD = Conduct Disorder;
DBDRS = Disruptive Behavior Disorder Rating Scale;
ODD = Oppositional Defiant Disorder;
PDD-NOS = Pervasive Developmental Disorder-Not Otherwise Specified;
SES = Socioeconomic Status;
TTI = Teacher Telephone Interview.

[a] SES was measured by parental educational level (average of both parents) through an adapted version of Statistics Netherlands' classification system (1 = primary education, 2 = secondary vocational education, 3 = secondary general education, 4 = undergraduate school, 5 = graduate school; Netherlands Statistics, 2006).

A total of 271 people (teachers, parents and professionals such as school counselors) requested information on study participation. For 152 children, written informed consent was obtained, after which eligibility of these children was assessed. Two children were excluded based on the teacher-rated DBDRS, two based on the TTI, three for receiving a (pharmacological) treatment and two for having a neurological condition. Besides that, fifteen children were excluded because the maximum of two students per classroom and five classes per school was reached, and fourteen children due to the use of a classroom program interfering with the behavioral program of the effectiveness study. Finally, three students were excluded because their teachers were opposed to the administration of sociometric measures in their classroom.
Sociometric information of the 2,526 classmates were gathered to calculate norm scores of each classroom and to determine whether the participants with ADHD symptoms experienced more peer problems compared to their classmates. No other information was available for these classmates, because the sociometric data of the classmates were collected as part of the larger effectiveness study in children with ADHD symptoms.

Materials

Sociometric measures

Peer ratings and peer nominations

Peer ratings and peer nominations were used to assess peer relations. For peer ratings, participants and their classmates were presented a list with the names of all their classmates, asking them to indicate how much they liked each classmate on a 5-point Likert scale (1 = dislike very much, 3 = neutral, 5 = like very much; Hoza, Mrug et al., 2005). Explanatory faces (from frowning to smiling) were placed above the numbers to facilitate the interpretation of the numbers. For peer nominations, children were asked to write down the names of three classmates who they considered to be their first, second, and third best friends (positive nominations), and up to three classmates they did not want to be friends with (negative nominations). As reliability is higher for peer ratings ($r = 0.64$) than for peer nominations ($r = 0.47$ and $r = 0.44$; Olsen et al., 2001), most outcome measures in this study were derived from the peer ratings (except for the number of dyadic friendships). All outcome measures are described below and in Table 2.

Social Preference and Impact

To measure the popularity and visibility of participants among peers, Social Preference and Social Impact were calculated from the peer ratings of all classmates, following the procedure of Maassen and colleagues (Maassen et al.,

1996). First, ratings (1 – 5) were converted into a bipolar scale ranging from -2 to 2, with the sum of all positive scores received from classmates reflecting peer acceptance, and the absolute value of the summed negative scores reflecting peer rejection. Then, peer acceptance and rejection scores were translated into z-scores per classroom (z = (*X participant* – classroom *M*)/Classroom *SD*). Social Preference was calculated as the difference between (standardized) acceptance and rejection scores (acceptance – rejection), and Social Impact was the sum of the absolute (standardized) scores.

Rejected Status

The percentage of participants with a rejected status was used as depended variable to determine how often children with high levels of ADHD symptoms were rejected compared to classmates. For this purpose, the social status of each child (participants and their classmates) was calculated, using standardized scores (z-scores) of peer acceptance, peer rejection, social preference and social impact (Maassen et al., 1996). Following Maassen's procedure, the child was assigned the rejected status if the child obtained a low social preference score (< 1 *SD*), a low peer acceptance score (< 0) and a high peer rejection score (> 0).

Dyadic Friendship

Based on the three positive peer nominations (first, second, and third best friends), the number of reciprocal friendships was determined for each participant and his or her classmates (Blachman & Hinshaw, 2002). All three nominated friends were regarded equal in terms of nominated friendships. Hence, if a child nominated another child as a friend and that friend nominated the child in the list of three best friends, this was regarded as a dyadic friendship.

Positive and Negative Imbalance

To calculate positive and negative imbalance scores, the peer rating (score from 1 to 5) that a participant gave to each classmate was compared to the rating that the participant received from each of these classmates. Positive Imbalance was calculated by summing the positive difference scores, for which the participant received better (higher) score than he or she gave. Negative Imbalance was calculated as the absolute value of the summed negative difference score, for which the participant received a worse (lower) score than he or she gave.

Nominated and Nominating Peers

The average of the Social Preference and Social Impact scores of the three classmates nominated by participants as friends (Positively Nominated Peers)

and non-friends (Negatively Nominated Peers) was calculated (Hoza, Mrug et al., 2005). Additionally, the number of classmates nominating the participant as friends (Positively Nominating Peers) and non-friends (Negatively Nominating Peers) was compared to the average number of Positively and Negatively Nominating Peers of their classmates.

Behavioral measures

ADHD Symptoms

Symptoms of Inattention and Hyperactivity/Impulsivity were assessed using the teacher version of the Strengths and Weaknesses of ADHD-symptoms and Normal Behavior (SWAN; Swanson et al., 2006). This rating scale contains two scales measuring Inattention (9 items) and Hyperactivity/Impulsivity (9 items) on a continuum, using a 7-point Likert scale (-3 = far above average, +3 = far below average; Young et al., 2009). All items were reverse scored for consistency with the direction of the other measures used in this study, with higher scores indicating more ADHD symptoms. The internal consistency for the teacher SWAN in the current study was high (Cronbach's $\alpha = 0.91$). The convergent validity of the SWAN is adequate ($r = 0.54$ with the Hyperactivity/Impulsivity scale of the Strength and Difficulties Questionnaire; Lakes, Swanson, & Riggs, 2012). Scores on the Inattention and Hyperactivity/Impulsivity scale served as outcome measures.

Behavioral Problems and Prosocial Behavior

Behavioral problems and prosocial behavior were measured with the teacher version of the Strengths and Difficulties Questionnaire (SDQ, Dutch version; Goedhart et al., 2003), comprising 25 items on a 3-point Likert scale (0 = not true, 1 = somewhat true, and 2 = certainly true). The scales Conduct Problems, Emotional Problems, and Prosocial Behavior were used in this study as predictors of impaired peer relations. The internal consistency of the teacher SDQ scales (Dutch version) is good ($0.74 < \alpha < 0.81$) and adequate concurrent validity with other measures of psychopathology has also been established (Van Widenfelt et al., 2003).

Procedure

This study was carried out in the Netherlands between September 2011 and July 2014 and was part of a larger study investigating the effectiveness of a behavioral teacher program for children with ADHD symptoms (Veenman et al., 2016). Dependent measures for this study were obtained prior to the start of the intervention. Procedures were approved by the local medical ethical committee (reference number 2011/196). Teachers and parents were recruited through educational consultant associations, the national parent association for children

with developmental problems, and the study's website. Teachers who were interested in participating, enlisted one or two children displaying ADHD symptoms in their classroom for whom they wanted to use the behavioral program. For all participants, written consent was obtained from teachers, parents, and children older than 11 years. Thereafter, these children were screened using the DBDRS (teacher version), and children who obtained elevated levels of inattention or hyperactivity/impulsivity on the DBDRS (>90th percentage) were further assessed with the Teacher Telephone Interview (TTI). After a participant was included in the study, parents of participant's classmates received an information letter explaining the study and an offer to opt out (3%). For children in grade 1 and 2, both sociometric measures were administered individually in a quiet room, to assure they understood the instructions and were not overheard by classmates. All other children received instructions in their classroom with tables separated from each other to allow private ratings. Teachers completed the SWAN and SDQ online.

Statistical analyses

To determine whether peer relations of children with high levels of ADHD symptoms differed from their classmates, all variables (see Table 2), except for Rejected Status, were standardized (*z*-scores) at the level of classrooms using the sociometric data of participants' classmates. Subsequently, it was calculated whether the average *z*-score of the children with ADHD symptoms differed significantly from zero (i.e., the score of the average classmate), by converting the *z*-scores into *t*-scores using the formula $t = z - \mu / (SD / \sqrt{(n-1)})$, with $\mu = 0$ and $SD = 1$. For the dichotomous variable Rejected Status (i.e., being rejected or not), the percentage of rejected participants was compared to the average percentage of rejected classmates across all classrooms. To test for significance, the standard error of the proportions was calculated using the formula $\sqrt{((p*q)/N)}$, after which it was assessed whether the percentage of rejected classmates fell within the confidence interval (CI +/- 2 *SE*). To adjust for multiple testing, *p*-values were corrected using the false discovery rate (FDR) control method (12 outcomes; Glickman, Rao, & Schultz, 2014). Effect sizes were determined using Cohen's *d* with values of 0.20, 0.50 and 0.80 as thresholds of small, medium, and large effect sizes, respectively (Cohen, 2013). To assess whether results were confounded by possible gender differences (16% of the participants were girls; Johnson, 2004; Phillipsen, 1999), sensitivity analyses were performed for all outcomes for boys only.

For peer outcomes on which participants showed significant impairments, multilevel regression analyses were conducted to explore whether these peer problems were related to symptoms of Inattention, Hyperactivity/Impulsivity,

Conduct Problems, Emotional Problems, and Prosocial Behavior. The Statistical Package for the Social Sciences (SPSS; Statistics, 2012) was used to conduct these analyses. Three hierarchical levels were distinguished in the multilevel analyses: participants (level 1), nested in classrooms (level 2), nested in schools (level 3; Heck, et al., 2013). When the intercept variance at a specific level was zero, the three-level models were reduced to two- or one-level models. First, we assessed whether each of the five behaviors (Inattention, Hyperactivity/Impulsivity, Conduct Problems, Emotional Problems and Prosocial Behavior) were separately related to each peer problem. Thereafter, a backward regression was performed for each outcome, stepwise excluding the behavior with the smallest association until the final model included significant behaviors only. All analyses were controlled for possible age and gender differences (Johnson, 2004; Phillipsen, 1999). Additionally, we explored for each behavior separately, whether its associations with the peer problems interacted with age, because age-specific effects may be expected (Waas & Graczyk, 1999). The interaction with gender was not assessed, because percentage of girls in the current sample was rather small (16%). However, a sensitivity analysis was performed on boys only, to evaluate whether the associations between the behaviors and peer problems were similar when girls were excluded from these analyses. In all multilevel regression analyses a significance level of .05 was used.

RESULTS

Missing values

There were no missing data for peer nominations, and for peer ratings this was 1.8%. The percentage of missing data for the SWAN and the SDQ was 3.6% and 1.8%, respectively. The missing data were assumed to be completely at random and were, therefore, not imputed.

Peer problems

Our analyses revealed significant differences between children with high levels of ADHD symptoms compared to their classmates for all, but three, peer outcomes. These results are depicted in Table 2. Children with high levels of ADHD symptoms scored significantly lower on Social Preference, higher on Social Impact, and had fewer Dyadic Friendships (1.2 friends out of 3 for children with ADHD symptoms compared to 1.5 friends for classmates). Children with high levels of ADHD symptoms were also more often rejected (36% compared to 16% of their classmates; 27% < CI < 45%), and more often nominated as non-friend. In fact, children with ADHD symptoms were regarded as non-friend by 21% of their classmates, while this percentage was 11% for other classmates.

Furthermore, children with high levels of ADHD symptoms had a lower Positive Imbalance and higher Negative Imbalance. Finally, the Social Preference of their Positively Nominated Peers was lower compared to classmates, while the Social Preference of their Negatively Nominated Peers was higher. The Social Impact of the Positively and Negatively Nominated Peers did not significantly differ from classmates. Although our results suggested that the number of classmates nominating our participants as friend was lower than their classmates, this difference was not significant after FDR correction. The sensitivity analyses on boys alone revealed similar results for all outcome measures and thus confirm the robustness of our findings.

As post-hoc analysis on the level of imbalance, it was assessed whether there was also an imbalance in likeability between children with ADHD symptoms and their Positively Nominated Peers. This was done by first calculating the average difference in liking score that each child gave to and received from their three

Table 2. Summary of outcome measures and peer impairments in children with ADHD compared to classmates

Measure	Definition
Social Preference	Acceptance (z-score) – Rejection (z-score)
Social Impact	Acceptance (z-score) + Rejection (z-score)
Rejected Status	Percentage of participants with rejected status compared to the nr. of rejected classmates
Dyadic Friendship	Nr. of reciprocal friendships based on the three positive nominations
Positive Imbalance	Sum of difference between the rating given and received from each class-mate if the child received better (higher) score than given to that classmate
Negative Imbalance	Sum of difference between the rating given and received from each classmate, if the child received a worse (lower) score than he gave
Positively Nominated Peers (PED)[a]	
- PED Social Preference	Average Social Preference for PED
- PED Social Impact	Average Social Impact for PED
Negatively Nominated Peers (NED)[b]	
- NED Social Preference	Average Social Preference for NED
- NED Social Impact	Average Social Impact for NED
Positively Nominating Peers (PNG)[c]	
- Total number of PNGs	Nr. of classmates nominating target child as 1st, 2nd, or 3rd best friend
Negatively Nominating Peers (NNG)[d]	
- Total number of NNGs	Nr. of classmates nominating target child as non-friend

Positively Nominated Peers. As done for all outcome measures, scores were then standardized (z-scores) at classroom level, after which it was compared whether children with ADHD symptoms significantly differed from their classmates (see Procedure section, subheading Statistical analyses). Results of the post-hoc analyses revealed that, compared to classmates, children with ADHD symptoms received lower liking scores from their Positively Nominated Peers than they gave those peers.

Behavioral Problems Associated with Peer Problems

Correlations among the five problem behaviors were below 0.60 (see Supplement 1). Correlational analyses were conducted between all peer outcomes to determine the interrelatedness between all outcome measures (see Supplement 2). For peer relations, Spearman's *r* was used for all interrelations with the dichotomous variable Rejected Status and Pearson's *r* for all other interrelations. Variables with high interrelations ($r > 0.80$) were removed as dependent variable from the subsequent analyses exploring the associations between problem behaviors and peer problems. Rejected Status correlated

		Peer impairments		
	Score type	**Test statistic**	*D*	
	z	$t = -6.35$***	0.61	
	z	$t = 3.39$***	0.33	
	%	36% (versus 16%) 27% < CI < 45%		**Note.** PED = Positively Nominated Peers;
	z	$t = -3.40$***	0.32	NED = Negatively Nominated Peers;
	z	$t = -4.32$***	0.42	PNG = Positively Nominating Peers; NNG = Negatively Nominating Peers.
	z	$t = 5.07$***	0.49	[a] Mean of classmates nominated by target child as first, second or third best friend.
	Mean of *z* scores	$t = -2.55$*	0.25	[b] Mean of classmates nominated by target child as a non-friend.
	Mean of *z* scores	$t = -1.04$	-	[c] Mean of classmates who nominated the target child as first, second or third best friend.
	Mean of *z* scores	$t = 2.63$*	0.25	[d] Mean of classmates who nominated the target child as a non-friend.
	Mean of *z* scores	$t = -0.31$	-	
	z	$t = -2.10$*^	0.20	* $p < .05$ ** $p < .01$ *** $p < .001$
	z	$t = 6.84$***	0.42	^ Not significant after FDR correction.

strongly with Social Preference (r = -.83, p < .01), while also revealing substantial correlations with the Number of Negatively Nominating Peers (peers nominating participants as non-friend; r = .62, p < .01) and with Negative Imbalance (r = .58, p < .01). Therefore, Rejected Status was removed from all subsequent analyses.

In Table 3, results are shown of the multilevel regression analyses exploring which problem behaviors were related to which peer problems. Results show that higher levels of Inattention and Conduct Problems were both related to low Social Preference and to high Negative Imbalance.

Additionally, a positive association was found between Prosocial Behavior and Social Preference, and between Hyperactivity/Impulsivity and Negative Imbalance. In the final model, however, only Conduct Problems remained significantly related to Social Preference and Negative Imbalance. Higher ratings of Conduct Problems

Table 3. Multilevel models indicating the associations between behaviors and peer relations

Fixed effects	**Preference Coefficient (*SE*)**	**Social Impact Coefficient (*SE*)**	**#Dyadic Friends Coefficient (*SE*)**	**Pos. Imbalance Coefficient (*SE*)**
Separate associations				
Inattention	-0.34 (0.13)*	-0.05 (0.14)	-0.13 (0.11)	-0.11 (0.10)
HI	-0.25 (0.13)*	0.15 (0.13)	0.04 (0.11)	-0.14 (0.10)
Conduct problems	-0.16 (0.05)**	0.03 (0.05)	-0.03 (0.04)	-0.09 (0.04)*
Emotional Problems	-0.09 (0.06)	0.01 (0.06)	-0.17 (0.04)*	-0.05 (0.04)
Prosocial behaviour	0.11 (0.05)*	-0.15 (0.05)**	-0.03 (0.04)	0.03 (0.04)
Final model of backward regression				
Inattention	-†	-	-	-
HI	-	-	-	-
Conduct problems	-0.16 (0.05)**†	-	-	-0.09 (0.04)
Emotional problems	-	-	-0.17 (0.04)*	-
Prosocial behaviour	-	-0.15 (0.05)**	-	-

Note. Random effects are not displayed in this table but can be obtained upon request.
HI = Hyperactivity/Impulsivity;
NED = Negatively Nominated Peers;
Neg. = Negative;
NNG = Negatively Nominating Peers;
PED = Positively Nominated Peers;
Pos. = Positive;
Preference = Social Preference.

were also related to lower Positive Imbalance scores and to more classmates nominating the target child as a non-friend. Low levels of Prosocial Behavior were associated with a high Social Impact. More Emotional Problems were related to less Dyadic Friendships. Not a single problem behavior was related to the Social Preference scores of the classmates nominated by the target child as friend or as non-friend.

Sensitivity analyses on boys alone

When performing sensitivity analyses on the associations between the behaviors and all peer outcomes on boys only, the results remained unchanged for most outcomes. Only for Social Preference and Negative Imbalance, the associations with Inattention were stronger (see Table 3). The final model for Social Preference now only included Inattention as significant variable, instead of Conduct Problems. For Negative Imbalance, the final model now included both Inattention and Conduct Problems.

	Neg. Imbalance Coefficient (*SE*)	**# NNGs Coefficient (*SE*)**	**PED Preference Coefficient (*SE*)**	**NED Preference Coefficient (*SE*)**
	0.39 (0.13)**	0.08 (0.15)	-0.02 (0.13)	-0.08 (0.13)
	0.41 (0.12)**	0.20 (0.14)	-0.06 (0.13)	-0.06 (0.13)
	0.19 (0.05)***	0.19 (0.06)**	-0.09 (0.05)	-0.05 (0.05)
	0.08 (0.05)	0.03 (0.06)	-0.06 (0.06)	0.07 (0.05)
	-0.01 (0.05)	-0.10 (0.05)	0.04 (0.05)	0.02 (0.05)
	-††	-	-	-
	-	-	-	-
	0.19 (0.05)*** ††	0.19 (0.06)**	-	-
	-	-	-	-
	-	-	-	-

† In the sensitivity analysis on boys only, Inattention was now significantly related to Social Preference ($b(SE) = -0.35(0.14)$, $p = 0.02$), while the relation with Conduct Problems was no longer significant in this final model.

†† The sensitivity analysis on boys only revealed that both Inattention and Conduct Problems were now significantly related to Negative Imbalance in the final model ($b(SE) = 0.29(0.13)$, $p = .03$ and $b(SE) = 0.15(0.05)$, $p = .10$, respectively).

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Interactions with age

The analyses assessing the interaction between problem behaviors and age (see Table 4) revealed that for both Social Preference and the number of Dyadic Friendships, Inattention interacted with age (p = .045 and p = .006, respectively), suggesting that their inverse relations with Inattention were stronger for younger children. For Dyadic Friendships, an interaction effect was found between Hyperactivity/Impulsivity and age (p = .010), suggesting that more Hyperactivity/Impulsivity was related to fewer Dyadic Friendships in younger children, while being related to more Dyadic Friendships in older children. A significant interaction between Hyperactivity/Impulsivity and age was also found for Social Preference of the Positively Nominated Peers (p = .005), indicating that Hyperactivity/Impulsivity in younger children was related to a higher Social Preference of the peers nominated as friends, whereas Hyperactivity/Impulsivity in older children was related to a lower Social Preference of these peers nominated as friends.

Table 4. Models with a significant Age*Behavior interaction on peer relations

	Preference	**Social Impact**	**#Dyadic Friends**	**Pos. Imbalance**
Fixed effects	**Coefficient (*SE*)**	**Coefficient (*SE*)**	**Coefficient (*SE*)**	**Coefficient (*SE*)**
Inattention	-0.38 (0.13)**	-	-0.24 (0.11)*	-
Age	0.06 (0.06)	-	0.04 (0.05)	-
Inattention*Age	0.14 (0.07)*	-	0.16 (0.06)**	-
HI	-	-	-0.02 (0.11)	-
Age	-	-	0.03 (0.05)	-
HI*Age	-	-	0.17 (0.06)*	-
Conduct Problems	-	-	-	-
Age	-	-	-	-
Conduct*Age	-	-	-	-
Emotional Problems	-	-	-	-
Age	-	-	-	-
Emotion*Age	-	-	-	-
Prosocial Behavior	-	-	-	-
Age	-	-	-	-
Prosocial*Age	-	-	-	-

Note. Random effects are not displayed in this table but can be obtained upon request. The Conduct Problems*Age and Emotional Problems*Age interactions were not significant for any of the models and are therefore not displayed in this table.

Additionally, for the number of Negatively Nominating Peers, an interaction was found between Conduct Problems and age (p = .045). This interaction suggests that the positive association between Conduct Problems and the number of peers nominating participants as non-friend was slightly stronger for younger children. For Social Preference of the Negatively Nominated Peers, an interaction was found between Prosocial Behavior and age (p = .005). This interaction suggests that for older children with ADHD symptoms, low levels of Prosocial Behavior are related to higher Social Preference of the peers nominated by the target child as non-friend.

DISCUSSION

The main aim of this study was to assess peer problems in a sample of children with high levels of ADHD symptoms in the classroom, using an extensive set of sociometric peer measures including both horizontal and vertical aspects of peer relations. Additionally, we aimed to explore whether specific problem behaviors associated with ADHD were related to the observed peer problems within this group.

Neg. Imbalance Coefficient (*SE*)	**# NNGs Coefficient (*SE*)**	**PED Preference Coefficient (*SE*)**	**NED Preference Coefficient (*SE*)**
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-0.004 (0.13)	-
-	-	-0.06 (0.06)	-
-	-	-0.20 (0.07)**	-
-	0.22 (0.06)***	-	-
-	-0.03 (0.06)	-	-
-	-0.06 (0.03)*	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	0.02 (0.04)
-	-	-	0.31 (0.11)**
-	-	-	-0.08 (0.03)**

HI = Hyperactivity/Impulsivity;
NED = Negatively Nominated Peers;
Neg. = Negative;
NNG = Negatively Nominating Peers;
PED = Positively Nominated Peers;
Pos. = Positive;
Preference = Social Preference.

* p < .05.
** p < .01.

Peer problems in children with ADHD symptoms

Results revealed that children with high levels of ADHD symptoms were highly impaired on nearly all investigated horizontal and vertical aspects of peer relations compared to their classmates. More specifically, children with ADHD symptoms had a lower social preference, higher social impact, fewer dyadic friendships, and they were more often rejected and nominated as non-friend. Furthermore, children with ADHD symptoms had a lower positive imbalance and higher negative imbalance. This indicates that they liked their peers more than they were liked by those peers, compared to classmates. Children with ADHD symptoms also received lower liking scores from the peers that they nominated as friends compared to the liking score they gave those peers. Finally, children with high levels of ADHD symptoms nominated peers with a lower social preference as friends, while their non-friends obtained higher social preference scores. Effects sizes for social preference, number of negatively nominating peers, and negative imbalance were moderate to large (d = 0.49 - 0.61), while effects on the other outcomes were small (d = 0.25 - 0.33).

As the majority of our sample (91%) involved children without an ADHD diagnosis, the current results suggest that non-referred children with high levels of ADHD symptoms at school experience substantial peer problems. The problems observed are comparable to those found in children diagnosed with ADHD, although effect sizes are smaller (Blachman & Hinshaw, 2002; Erhardt & Hinshaw, 1994; Hinshaw, 2002; Hodgens et al., 2000; Hoza, Mrug et al., 2005). In Hoza's study (2005), for example, larger effects were found for most outcomes, with highest effects for social preference and negative imbalance reaching Cohen's d's of 1.17 and 1.22, respectively (while in our study Cohen's d's of 0.61 and 0.49 were found for social preference and negative imbalance, respectively). Additional analyses of our sample excluding children with a clinical diagnosis of ADHD (results not reported here and available upon request), showed similar findings to those obtained with the full sample for all peer outcomes, except for the effect on social preference of the positively nominated peers which was no longer significant. These findings further corroborate that non-referred children with ADHD symptoms experience profound peer problems. The results of this study further reveal that children with ADHD symptoms from different cultures (American as well as Dutch) tend to show similar peer problems. This suggests that peer problems in children with ADHD symptoms are universal, regardless of the cultural background of a child.

This study is the first to show that non-referred children with high levels of ADHD symptoms like their peers more than those peers like them, as shown by the lower positive and higher negative imbalance scores. Moreover, children with ADHD symptoms also had fewer dyadic friendships and were liked less by the peers they regarded as friends compared to how much they liked those peers. This confirms the idea that children with ADHD symptoms have difficulty selecting peers as friends that are likely to reciprocate the friendship (Hoza, Mrug et al., 2005). The current findings are in line with the positive illusory bias often reported in children with ADHD, which is characterized by an overestimation of their social performance and of the quality of their friendships (Diener & Milich, 1997; Hoza et al., 2004; Marton et al., 2015). This illusory bias is thought to protect against negative outcomes such as depression (Hoza, Murray-Close, Arnold, Hinshaw, & Hechtman, 2010). Unlike Hoza et al. (2005), the current results also showed that children with high levels of ADHD symptoms nominated classmates of lower social preference as friends, while they nominated classmates of a higher social preference as non-friends. This finding is in line with other studies involving community samples revealing that disliked children or children with behavioral problems tend to associate with each other (Mariano & Harton, 2005; Nangle, Erdley, & Gold, 1996).

Problem Behaviors Associated with Peer Problems

Our findings indicated that ADHD symptoms (both inattention and hyperactivity/impulsivity) and conduct problems were related to most peer problems, particularly to social preference and negative imbalance. Conduct problems seemed most strongly related to social preference and negative imbalance in the full sample, while the sensitivity analyses suggested stronger associations with inattention in boys only. Having fewer dyadic friendships was related to more emotional problems and more ADHD symptoms (particularly in younger children), while less prosocial behavior was related to a lower social preference and a higher social impact. As both inattention and hyperactivity/impulsivity are related to peer problems, targeting peer problems in these children (e.g., with the intervention Making Socially Accepting Inclusive Classrooms, MOSAIC; Mikami et al., 2013) is crucial for all children displaying ADHD symptoms, regardless of the type of ADHD symptoms.

The current findings are in largely line with other studies, in which aggression explained more variance regarding peer problems than ADHD symptoms (Diamantopoulou et al., 2007; Zucchetti et al., 2015) and in which social preference was inversely related to ADHD symptoms, aggression and low levels

of prosocial behavior (Bellanti & Bierman, 2000; Diamantopoulou et al., 2007; Hoza, Mrug et al., 2005; Pope, Bierman, & Mumma, 1989). The peer unpopularity of children displaying ADHD symptoms with comorbid conduct problems could be driven by their disruptive, unrestrained and oppositional behavior that is likely to hamper positive peer interactions, while inattentive children without comorbid problems are more likely to experience peer problems due to social withdrawal and passivity (Hodgens et al., 2000; Mrug, Hoza, & Gerdes, 2001; Wheeler Maedgen & Carlson, 2000). Our study extends on previous work by showing that having more conduct problems is related to higher levels of imbalance. This larger discrepancy between being liked and disliked in case of more conduct problems could be related to the positive illusory bias, which appears to be largest in children with both ADHD and comorbid conduct problems (Hoza et al., 2004). The stronger association of inattention with negative imbalance in the sample with only boys, could be explained by a reduced ability to attend to social cues, which could disrupt social interaction with peers (Diener & Milich, 1997; Stormont, 2001). In addition, this may impair their ability to estimate whether the peer is likely to the reciprocate his likability or friendship.

Results also showed that the negative associations of ADHD symptoms and conduct problems on multiple aspects of peer relations were stronger for younger than for older children. In fact, hyperactivity/impulsivity in older children was related to more dyadic friends, albeit their friends had a lower social preference than other classmates. This suggest that when children with ADHD symptoms grow older, their hyperactive and impulsive behavior may attract peers with similar behavioral problems who are also rejected by the larger peer group. Unfortunately, we could not assess the behavioral characteristics of participants' friends and non-friends in the current study, because this information was not collected for participants' peers. Similar age-related effects have been reported by others revealing disruptive and aggressive behavior to be condemned more by younger than by older children (Sandstrom & Coie, 1999; Waas & Graczyk, 1999), but see also other literature reporting no age-related effects (Hoza, Mrug et al., 2005; Normand et al., 2011). An explanation for these age effects might be that peer relations and dyadic friendships are in development and less stable during the first years of primary school compared to the upper grades in which 'cliques' of peers are formed and become increasingly stable (Cairns, Leung, & Cairns, 1995; Cairns, Leung, Buchanan, & Cairns, 1995). During these first school years, the formation of friendships and peer popularity might thus be hampered more by behavioral problems

compared to later years. This explanation is in line with literature indicating that older children with ADHD symptoms are more likely to associate with other disliked friends with behavior problems (Marton, 2015; Mariano 2005), who might even support or encourage the display of hyperactive/impulsive and aggressive behavior (Luthar & McMahon, 1996).

Limitations

Some limitations of this study need to be considered. First, given the exploratory nature of our analyses, we did not control for multiple testing in the multilevel regression analyses exploring which behavioral problems were related to which peer problems. Our findings do suggest that different behavioral problems are associated with different aspects of peer problems, however this awaits replication. Second, a prospective longitudinal design would have been more appropriate to investigate age effects than our cross-sectional design and should be used to confirm our findings regarding age. Third, we did not have any information on the classmates who served as controls, such as demographic or behavioral characteristics reported by teachers. Therefore, we could not investigate whether these children were representative of the general population in terms of their behavioral characteristics. However, the chance that our results were confounded by demographic differences such as social economic status is limited as the classmates of each child with ADHD symptoms were used as reference group. Finally, some caution is warranted with the generalization of the current findings to girls with ADHD symptoms due to the small percentage of girls in our sample (16%). However, results of the sensitivity analyses on boys alone showed that findings remained largely unchanged (except for the stronger associations of inattention with two peer outcomes).

Conclusion

This is the first study to investigate multiple aspects of peer relations in a European sample of children with high levels of ADHD symptoms, demonstrating that these children are substantially impaired in many horizontal and vertical aspects of peer relations. Additionally, we explored whether specific behavioral problems were related to these peer problems. As expected, mainly hyperactivity/impulsivity, inattention and conduct problems were related to many peer problems, although strongest relations were found for conduct problems. The relationship between both ADHD symptoms and conduct problems with peer problems was stronger for younger than for older children. Nevertheless, for older children, hyperactivity/impulsivity was related to more reciprocal friendships with peers that were (also) rejected by the larger peer group. Given

the substantial peer problems in non-referred children with ADHD symptoms and the difficulty of changing negative peer regard once established (Mrug et al., 2007), interventions appear crucial and might help to prevent further escalation of problem behavior into a full diagnoses of ADHD. For example, peer-based interventions, in which a child with ADHD symptoms is coupled with a more popular, prosocial classmate might help to foster friendship initiation and improve positive peer relations (Hoza, Mrug, Pelham Jr, Greiner, & Gnagy, 2003).

Supplement 1. **Pearson's correlations between behavioral measures**

	1	2	3	4	5
1. Inattention	1	0.54**	0.40**	0.06	-0.13
2. Hyperactivity/Impulsivity		1	0.54**	-0.06	-0.26**
3. Conduct problems			1	0.07	-0.34**
4. Emotional problems				1	0.05
5. Prosocial behavior					1

* $p < .05$ ** $p < .01$

Supplement 2. **Correlations between peer outcomes**

	1	2	3	4	5	6	7	8
1. Preference	1	-0.20*	0.38**	0.46**	-0.69**	-0.72**	0.22	-0.29
2. Social Impact		1	0.22*	-0.10	0.06	0.35**	-0.09	0.14
3. Dyadic friends			1	0.08	-0.29**	-0.11	-0.13	-0.13
4. Pos. Imbalance				1	-0.72**	-0.35**	0.17	-0.08
5. Neg. Imbalance					1	0.47**	-0.20*	0.15
6. # NNGs						1	-0.16	0.23*
7. PED Preference							1	-0.27**
8. NED Preference								1

Note. All correlations are Pearson's correlations, except for the correlations between Rejected Status and all outcome measures, for which Spearman's correlations were used.
Dyadic Friends = Number of dyadic friendships;
NED = Negatively Nominated Peers (peers nominated by participants as not being their friend);
Neg. = Negative;
NNG = Negatively Nominating Peers (peers nominating participants as not being their friend);
PED = Positively Nominated Peers (peers nominated by participants as being their friends);
Pos. = Positive
* $p < .05$
** $p < .01$

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CHAPTER 7 Summary and General Discussion

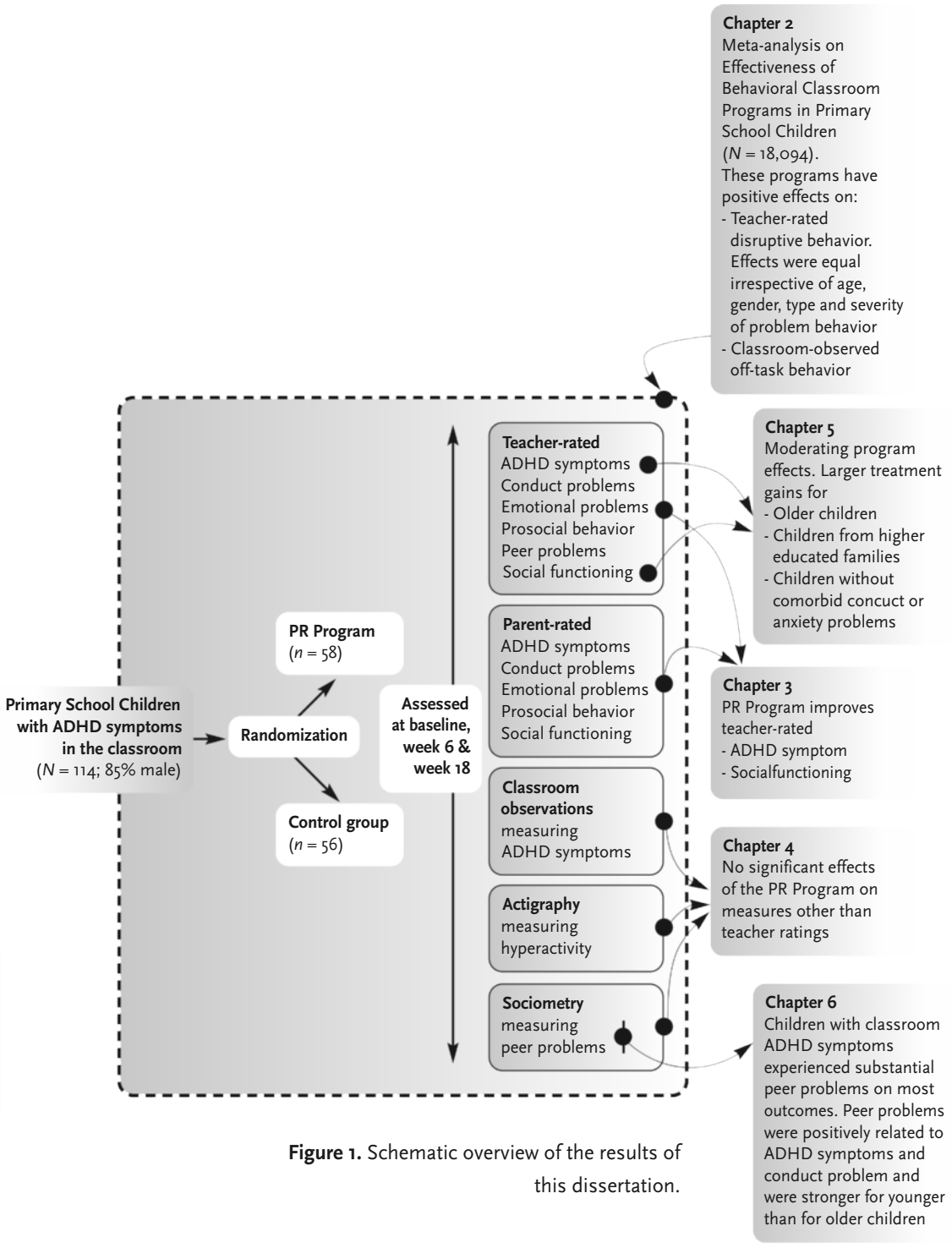

Figure 1. Schematic overview of the results of this dissertation.

The primary aim of this dissertation was to examine the effectiveness of the Positivity & Rules Program (PR program), a manualized behavioral teacher program targeting symptoms of Attention-Deficit Hyperactivity Disorder (ADHD) in the classroom. A diverse set of instruments were used (e.g., teacher and parent ratings, classroom observations, actigraphy and peer ratings) to obtain a comprehensive view of the program's effectiveness, while also assessing moderators influencing the program's effectiveness. The second aim was to elaborately assess the peer problems experienced by children with ADHD symptoms. This aim was realized by investigating the relations of these children with their classmates through a diverse set of sociometric measures and by examining the association of ADHD symptoms (inattention and hyperactivity/impulsivity) and related problem behavior (conduct problems, emotional problems and prosocial behavior) with peer problems.

First, a summary will be provided of the main findings of each chapter (see also Figure 1). Thereafter, these findings will be integrated in a general discussion where the findings will be placed in a broader context, considering relevant literature. Subsequently, strengths and limitations, clinical implications and recommendations for future research are discussed.

Summary of the Main Findings

Chapter 2 provides a meta-analytic review on randomized controlled trials (RCTs) into the effects of behavioral classroom programs on disruptive behavior in the classroom (i.e., symptoms of ADHD, ODD and/or CD). The meta-analysis included 18 RCTs published between 1980 and 2016 and included 18,094 elementary school children. Results showed evidence for small but significant beneficial effects of behavioral classroom programs on teacher-rated disruptive behavior (d = -0.20) and on classroom-observed off-task behavior (d = 0.39). There were no significant effects of behavioral classroom programs on classroom-observed disruptive behavior. The effects of such programs on teacher-rated disruptive behavior were unrelated to age, gender, type of problem behavior (ADHD symptoms versus ODD/CD symptoms) and severity of problem behavior (comparing clinical, at-risk, and community samples). Shorter programs were more effective than more lengthy programs (R^2 = 0.43). As behavioral classroom programs were equally effective irrespective of age, gender, type and severity of problem behavior, results advocate using cost-effective universal programs for entire classrooms as first treatment when targeting disruptive classroom behavior. More intensive individual programs may then be reserved for children not responding adequately to universal behavioral programs.

In **Chapter 3**, an RCT was used to assess the effects of the PR program on teacher- and parent-reported behavioral, social, and emotional functioning of children with high levels of ADHD symptoms ($N = 114$). Compared to most behavioral teacher programs that often involve an intensive training, the manualized PR program does not include a face-to-face training for teachers and involves student-focused and classroom-focused strategies, thus holding promise for a sustainable large-scale implementation against little cost. The PR program involves elements of evidence-based behavioral classroom programs (e.g., the Summer Treatment Program; MTA Cooperative Group, 1999), such as psycho-education for the teacher, classroom behavior management strategies, and contingency management (e.g., a reward and time-out system; Pelham & Fabiano, 2008). Results of the RCT showed evidence for positive effects of the PR program on teacher-reported ADHD symptoms and on teacher-rated social skills ($0.01 < f^2 > 0.36$) in children receiving the PR program ($n = 58$) compared to controls ($n = 56$). Results also revealed a larger reduction of conduct problems for children in the intervention group compared to controls, but this effect was not significant when adjusting for baseline differences. No significant program effects were found on teacher-rated emotional problems, peer problems and prosocial behavior. There were no effects of the PR program on parent-rated outcomes, which implies that the positive effects on ADHD symptoms and social functioning did not generalize to the home setting. Satisfaction among teachers was high, as well as implementation fidelity. Given the positive program effects found in this study, the PR program holds promise for improving classroom behavior in children with ADHD symptoms.

Given teachers' involvement in treatment delivery, **Chapter 4** elaborates on Chapter 3 by investigating whether the positive teacher-rated effects of the PR program on ADHD symptoms and social functioning could be confirmed by classroom observations, actigraphy and peer ratings. Results on the actigraphy and classroom observations did not reveal beneficial effects of the PR program on ADHD symptoms, nor did the peer ratings reveal treatment gains on peer acceptance. Possible explanations of these negative findings may be that the PR program mainly improves the perception of the teacher rather than the child's behavior, or that the used instruments may have been insensitive to program-related improvements.

Correlational analyses between the teacher-rated ADHD symptoms and classroom observations, actigraphy and peer ratings revealed no significant correlations with one single exception: teacher-rated Hyperactivity/Impulsivity

was weakly related to actigraphic hyperactivity (r = -0.25, p = .012). The absence of program effects on the outcome measures used in this study, may thus be related to the different behavioral aspects measured by these instruments compared to teacher-rated ADHD symptoms. This study underlines the importance of using different measures of classroom behavior to study program effects.

Chapter 5 sheds more light on the beneficial teacher-reported effects of the PR program by exploring possible moderators of the program effects on ADHD symptoms and social functioning. Results showed that effects of the PR program on ADHD symptoms were larger for older children and for children from highly educated families. Results on ADHD symptoms further revealed smaller program effects for children with high levels of both ADHD symptoms and anxiety. For social functioning, results showed evidence for superior program effects for children scoring low on peer acceptance, and for children who scored low on social functioning and did not exhibit comorbid conduct problems. No moderating effects were found for gender, IQ, initial severity of problem behavior, nor for teacher experience and class size.

In sum, results indicated that treatment effects were larger for older children and for children from highly educated families, while comorbid conduct problems or anxiety impeded treatment gains. Our results suggest that the PR program is mainly suitable for children with ADHD symptoms not facing additional challenges. The program may not be able to address the needs of children from low-educated families and of those with comorbid psychopathology. These finding emphasizes that the PR program should be used in a preemptive stage before behavioral problems escalate or transfer to multiple domains.

In **Chapter 6** many diverse aspects of peer relations were elaborately assessed for children with high levels of ADHD symptoms, using an extensive set of sociometric peer measures. Additionally, this study explored whether specific problem behaviors (e.g., inattention and conduct problems) were related to the observed peer problems. Results indicated that children with high levels of ADHD symptoms (N = 111; 91% non-referred) were substantially impaired on many aspects of peer relations (d = 0.25 - 0.65) compared to their classmates (N = 2,526). Children with ADHD symptoms had a lower social preference (i.e., less popular), higher social impact, fewer dyadic friendships, and they were more often rejected and nominated as non-friend. Children with ADHD symptoms also liked their peers more than they were liked by those peers (i.e., negative

imbalance). Finally, children with ADHD symptoms nominated peers with a lower social preference as friends, while their non-friends had higher social preference scores, indicating that children with ADHD symptoms seek friends that are also less popular.

Furthermore, results showed that mainly hyperactivity/impulsivity, inattention and conduct problems were related to peer problems, although relationships were strongest for conduct problems. The associations between both ADHD symptoms and conduct problems with peer problems were stronger for younger than for older children. Nonetheless, hyperactivity/impulsivity in older children was related to more friendships with peers that were rejected by the larger peer group. Given the substantial peer problems of children with ADHD symptoms, early interventions for these children (such as the intervention 'Making Socially Accepting Inclusive Classrooms', MOSAIC; Mikami et al., 2013) appear crucial and might help to prevent further escalation of problem behavior into clinical ADHD.

General Discussion

The main aim of this dissertation was to investigate the effectiveness of the PR program. As described in the general introduction, the PR program distinguishes itself from other behavioral programs by the low intensity of the program and the ability for teachers to use the program without additional teacher training. This increases the likelihood that the program can be successfully implemented in practice and could be sustainable on the long-term against little cost.
A secondary aim was to thoroughly investigate peer problems of children with ADHD symptoms in the classroom.

Main Effects of the PR Program

The findings described in this dissertation showed that teachers using the PR program in their classroom observed small but significant improvements on ADHD symptoms and social functioning of student with high levels of ADHD symptoms (Chapter 3). These findings are in line with our meta-analytic results showing small, positive effects of behavioral teacher programs on teacher-rated symptoms of ADHD and ODD/CD (Chapter 2). In contrast with our meta-analysis no significant effects were found of the PR program on conduct problems, when controlling for baseline differences (Chapter 3). Neither were program effects found on teacher-rated peer problems (Chapter 3). Unfortunately, the treatment gains on ADHD symptoms and social functioning observed by teachers who were involved in treatment delivery, were not confirmed by other

measures (i.e., actigraphy, classroom observations, and peer ratings; see Chapter 4). This is in line with two meta-analyses that show small, positive effects of classroom behavioral programs on teacher-rated ADHD symptoms, whereas no program effects were found when using classroom-observations as measure of ADHD symptoms or disruptive behavior (Sonuga-Barke et al., 2013 and Chapter 2, respectively, but see also MTA Cooperative Group, 1999). The lack of treatment gains of the PR program on peer acceptance as measured by peer ratings corresponds with the lack of program effects on teacher-reported peer problems. Less-proximate measures (i.e., probably blinded measures) have captured positive effects of behavioral programs on off-task behavior (Chapter 2, meta-analysis), conduct problems and parenting (Daley et al., 2014, meta-analysis). This indicates that more objective evidence exists for the effectiveness of behavioral programs on a variety of outcome measures, despite the failure to find such evidence in the present RCT.

The results of Chapter 3 and 4 suggest that teacher-reported effects of the PR program on ADHD symptoms and social functioning might reflect a change in teacher perception regarding the child's functioning, rather than an actual behavior improvement of the student. This change in teachers' perception may be explained by teachers being biased due to positive treatment expectations and their investment in the program (Sonuga-Barke et al., 2013). Another explanation may be an increased tolerance or coping of teachers with ADHD symptoms (Daley et al., 2014), for example due to the psycho-education of the PR program, which might enhance positive attitudes and behavior towards individuals with ADHD (Nussey et al., 2013). Given the relatively low correlations between teacher-rated ADHD symptoms and other ADHD measures (i.e., classroom observation and actigraphy; Chapter 4), it is also possible that these instruments captured different aspects of the child's behavior. Another explanation to be considered is that classroom observations and actigraphic measures were unable to capture program-related improvements due to limitations of these instruments (see discussion of Chapter 4). For example, the duration of the classroom observation used in this study (2 x 8 minutes) might have been too short to capture program-related improvements. One example of a limitation inherent in actigraphy, is its inability to distinguish inappropriate hyperactivity from appropriate activity, such as raising your hand before asking a question.

As already discussed, we found positive effects of the PR program on teacher-rated social functioning of students with high levels of ADHD symptoms

(Chapter 3), and these effects were larger for children who were not liked by peers (Chapter 5). However, our teacher program did not improve teacher-rated peer problems nor peer acceptance (Chapter 3 and 4). These findings suggest that the PR program may improve social behavior of the student towards teachers, while not improving social behavior towards peers. This seems plausible as social interactions between the teacher and the student are generally more related to teachers' educational task than social interactions between classmates (Baker, 2006). Moreover, teachers using the PR program may have focused on targeting behavior disturbing teacher instructions and lessons, rather than focusing on behavior disrupting social interactions with peers. Another explanation might be that participants' negative behavior towards peers was reduced, without improving the negative perception of peers towards that child. Literature shows that peer rejection is difficult to change once established, even if negative behavior of the rejected child reduces over time (Mrug, et al., 2007). The stability of negative peer perceptions may also be explained by negative expectations of peers. Negative expectations can result in negative or ambiguous behavior of peers towards the disliked child and thus hamper positive behavior change of the disliked child (Harris, Milich, Corbitt, Hoover, & Brady, 1992). Another explanation for the stability of negative peer perceptions might be related to peers attributing behavior improvements of the disliked child to external factors (e.g., others being nice) or unstable factors (e.g., the child's mood; Hymel, 1986). Hence, it could be that the intervention period of 18 weeks was too short to improve the negative perception of peers regarding their classmate with ADHD symptoms.

Even though treatment gains were limited to teacher-rated outcomes, the importance of improving teacher perceptions of a child's behavior should not be underestimated. An improved perception of teachers may affect their behavior towards their student, which may improve the teacher-child interaction (Stuhlman & Pianta, 2002). A positive teacher-child interaction may result in enhanced school adjustment and academic achievement by fostering motivation, engagement in learning activities, and the development of social and behavioral competences (Pianta, 1999). A close teacher-child relationship can be particularly important for children displaying disruptive classroom behavior (e.g., ADHD symptoms) who often receive negative feedback from teachers and peers.
As teacher-child interaction was not assessed in our study, future research is necessary to examine whether the PR program can improve teacher-child interactions.

It could be argued that additional expert involvement could have improved the effectiveness of the PR program, but literature on this topic is inconsistent. While a review on the effectiveness of self-help interventions for parents of children with behavior problems suggests that adding minimal levels of therapeutic support improves child outcomes (O'Brien & Daley, 2011), another meta-analytic study suggests that self-help parenting interventions are equally effective compared to therapist-led parenting interventions (Tarver et al., 2014). So far, no studies have investigated the added effects of therapist support to low-intensive teacher programs. More research is needed to assess whether the effectiveness of the PR program can be improved through therapist involvement.

Moderating Effects of the PR Program

As discussed in Chapter 5, the beneficial effects of the PR program on teacher-rated ADHD symptoms were larger for older children, children from highly educated families and those without severe comorbid conduct or anxiety problems. These findings are in line our hypothesis that this low-intensive behavioral teacher program is more effective for children with ADHD symptoms not facing additional challenges, while more intensive therapeutic support appears needed for children from low-educated families and for those with severe comorbid problem behavior (van den Hoofdakker et al., 2010). Particularly comorbid conduct problems seem to impede treatment gains, because the current findings indicate that conduct problems are not effectively targeted by the PR program (Chapter 3). Moreover, in the case of comorbid conduct problems, the effect of the program on ADHD symptoms and social functioning is also smaller (Chapter 6). No moderating effects of the PR program were found for gender, IQ and initial severity of problem behavior, which is largely in line with our meta-analytic results revealing no moderating program effects of gender and severity of problem behavior (Chapter 2).

The moderating role of age found in this study is consistent with other studies revealing larger effects of behavioral programs for older children (Comer et al., 2013; van den Hoofdakker et al., 2010, but see also Nowak and Heinrichs, 2008, and Enebrink et al., 2012), while not being in line with our meta-analytic results (Chapter 2). Perhaps, older children can more easily inhibit their impulses and comply with the challenges imposed by teachers implementing the PR program than younger children, because brain development and socialization improve with age (Faraone, Biederman, & Mick, 2006).

Our finding that the PR program is more effective for children from highly educated parents, is in line with several reviews discussing predictors and

moderators of treatment outcomes in children with ADHD (Chronis et al., 2006; Hoza et al., 2006). In most of those treatments, however, parents were involved in delivery of treatments (e.g., medication and parent programs), in which case the moderating role of parental educational level could be explained by greater involvement and greater treatment adherence of highly educated parents (La Greca et al., 2009). This explanation is less likely in our study where parents were not involved in treatment delivery. A more likely explanation might be related to teachers' attitudes and expectations. Children from families with a low socioeconomic status (SES, often quantified by parental education) are often perceived less positively by teachers and teachers have lower expectations of these children in terms of academic and behavioral functioning (McLoyd, 1998). Hence, it is possible that teachers also expect less treatment improvement in these children.

Although the current results indicate that the PR program is equally effective for all children with ADHD symptoms, regardless of the severity of their ADHD symptoms, children with comorbid conduct or anxiety symptoms seem to profit less from this program. More specifically, no treatment gains on ADHD symptoms were found for anxious children with high levels of ADHD symptoms, while large improvements on ADHD symptoms were found for non-anxious children with high levels of ADHD symptoms. The reason that others did find larger treatment gains for behavioral programs in children with ADHD and comorbid anxiety (March et al., 2000; van den Hoofdakker et al., 2010; Van der Oord et al., 2008a) could be related to the larger involvement of parents in these programs. Parents of children with ADHD and comorbid anxiety symptoms could be more anxious and overprotective towards their child than parents of children without comorbid anxiety symptoms (Pfiffner & McBurnett, 2006) and might thus be more inclined to conform to treatment protocols (Van der Oord et al., 2008a), possibly resulting in larger treatment gains. In our manualized teacher program, parents were not involved in treatment delivery at all, which could explain the differences between the study results. Perhaps, the perceptions of teachers can explain the lower gains of the PR program for anxious participants. Anxious children are likely to show very intense help-seeking and proximity-seeking behaviors towards teachers, which could result in teachers perceiving the child as challenging and causing frustration (Pianta & Nimetz, 1991), thus impeding treatment gains. Providing teachers with more elaborate information on comorbid internalizing and externalizing problems in children with ADHD and additional therapeutic support might help to increase the effectiveness of the PR program (Gillberg et al., 2004).

Based on the findings of this dissertation, the low-intensive, manualized PR program appears to be a promising behavioral teacher program for children with ADHD symptoms not facing additional challenges. However, future research is necessary to assess whether instruments other than teacher-ratings can confirm the positive treatment gains of the PR program. Nonetheless, thanks to the low costs and the relatively low intensity of the PR program compared to other more intensive behavioral programs, this teacher program has the potential of being successfully and sustainably implemented on a large scale at little costs.

Peer Problems

In Chapter 6, we provide evidence for substantial peer problems of children with ADHD symptoms at school, such as being less popular and more often rejected, and having fewer and less popular friends. These impairments were positively related to inattention, hyperactivity/impulsivity, and comorbid conduct problems, although strongest relations were found for conduct problems. The relationship between both ADHD symptoms and conduct problems with peer problems was stronger for younger than for older children. Nevertheless, for older children, hyperactivity/impulsivity was related to more reciprocal friendships with peers that were (also) rejected by the larger peer group. Literature has shown that peer rejection is associated with a more negative self-perception (Ladd & Troop & Gordon, 2003) and more adjustment problems of children with ADHD, while also increasing the risk of adverse outcomes (e.g., maladjustment at school, mental health problems, and criminal offenses; Mikami & Hinshaw, 2006; Murray-Close et al., 2010; Parker et al., 2006). Given the substantial peer problems experienced by children with ADHD symptoms (Chapter 6) and the negative effects of these peer problems, improving the social skills of children with ADHD symptoms is extremely important. As it is very difficult to change negative peer perception after being established (Mrug et al., 2007), specific peer-based interventions such as the intervention 'Making Socially Accepting Inclusive Classrooms' (MOSAIC; Mikami et al., 2013) might help to improve positive peer relations in children with ADHD symptoms.

Strengths and Limitations

As already discussed previously, this study adds to the literature by describing the effectiveness of a behavioral teacher program that is less intensive compared to most similar programs, which require intensive and expensive teacher training. As funding is often not available after research is terminated, the long-term sustainability of such programs is often compromised. Consequently, the PR program could become a valuable contribution to existing behavioral programs

for having the potential to be implemented nation-wide against little costs. The high implementation fidelity and high teacher satisfaction regarding the PR program further supports the idea that this program could be successful on the long-term. Treatment fidelity was, however, assessed through teacher self-report rather than an independent classroom observation, but practical constraints precluded implementing observations of treatment fidelity in this study. Future research is necessary to assess whether the program's treatment fidelity can be confirmed through observations.

Another strength of this study is the use of actigraphy, classroom observations, and peer ratings to assess the effectiveness of the PR program. The number of well-designed randomized controlled trials (RCTs) using those instruments to investigate the effectiveness of behavioral teacher programs for ADHD is scarce, with only two of such RCTs using classroom observations (Miranda et al., 2002; MTA Cooperative Group, 1999), two using peer nominations to assess treatment gains on social functioning (Pelham et al., 1993b), and none using actigraphy. Despite the lack of positive program effects on measures other than teacher ratings, reporting these findings is still important to understand the scope of the program's effects. We, therefore, encourage other effectiveness trials to use and report on less-proximate outcomes as well.

Regarding the classroom observations, two limitations need to be mentioned. First, it should be noted that the observers were not blind to treatment allocation in our study due to the visibility of program elements within the classroom. Nonetheless, the current results were probably not influenced by this potential bias since no program-related effects in favor of the intervention group were found on classroom-observed ADHD symptoms. Second, we could not assess effects of the PR program on classroom-observed conduct problems due to extremely low levels of aggressive behavior during our classroom observations. Perhaps, the time-sampling approach used in our observations – although commonly used – might have been less appropriate to capture low-frequency behaviors such as aggression (Henry & Group, 2006). Instead, observations during a longer period or during more unstructured situations might have resulted in a more reliable estimate of the actual rates of aggression. Unfortunately, such observations are very time-consuming and expensive.

Another limitation of this study is the fact that we did not include a measure of teacher-child interaction. This precluded us to investigate whether the PR program did result in improved interaction between teachers and students with

ADHD symptoms. Given the lack of program effects on measures other than teacher ratings, this would have been a valuable contribution to the current results. As teachers noticed improvements of their student's behavior, it is likely that teacher gave more positive feedback to this child, which could have improved the teacher-child interaction (Stuhlman & Pianta, 2002). However, this claim awaits further research.

A further limitation of the current RCT is that treatment expectations of teachers and/or parents were not assessed. This prevented us from assessing whether the inconsistent results (treatment gains on teacher-reported ADHD symptoms and social functioning, but no program effects on actigraphy, classroom observations and peer ratings) could be explained by an expectation effect of teachers in the intervention group.

The unequal gender distribution in the current sample that mainly comprised boys (84%), limits the generalizability of the teacher-reported effects of the PR program to girls and precludes us from drawing firm conclusions on whether the program is equally effective for boys and girls. This is a common problem in ADHD research where boys are clearly overrepresented (Gershon & Gershon, 2002). Using community samples in effectiveness trials could help to assess the effectiveness of behavioral programs for girls with ADHD symptoms and to verify whether susceptibility to these programs depends on gender.

Finally, power was rather limited to find significant moderators influencing the program's effectiveness due to the relatively small sample size (Chapter 5). Limited power can be particularly problematic for three-way interactions, for example those assessing moderating effects of comorbid psychopathology (e.g., group x ADHD symptoms x conduct problems). Still, despite the limited power, it is worth mentioning that some significant ($\alpha < .05$) moderating three-way interactions were found (e.g., group x ADHD symptoms x anxiety problems).

Clinical Implications and Future Research

Based on the current findings, the PR program could be a promising intervention for a large group of children displaying ADHD symptoms at school, particularly for children from highly educated families and children without comorbid psychopathology. However, it should be noted that the effects of PR program were small, although it needs to be emphasized that behavioral interventions commonly yield small effects (Sonuga-Barke, et al., 2013). This implies that it might be necessary to use other treatments (e.g., a complementary parent

behavioral program or medication) in combination with this teacher behavioral program to normalize disruptive classroom behavior or to improve behavior at home.

Low-intensive cost-effective programs such as the PR program could be extremely valuable for teachers and schools. Due to the recent changes in the Dutch educational system (in the Netherlands referred to as 'Passend Onderwijs'), regular primary schools have the responsibility to retain children with psychiatric or learning disabilities in their schools if possible, thus reserving special education schools for children not functioning well in regular education. Given this obligation for regular primary schools to provide adequate education to a large group of children with psychiatric or learning disabilities, adequate knowledge and skills of teachers to cope with large diversity of problem behavior (e.g., ADHD symptoms) is essential. Unfortunately, many teachers report to have insufficient knowledge about ADHD and to feel insufficiently equipped to target these symptoms in the classroom (Moldavsky & Sayal, 2013; Rose et al., 2005). Meanwhile, teachers' workload is often high and class sizes are large, which increases the risk of burnout among teachers (Hakanen, Bakker, & Schaufeli, 2006; Kyriacou, 2001). Inexpensive behavioral programs of low intensity that are suitable for a large group of children might thus be valuable for many teachers. As the PR program includes both student-focused and classroom-focused strategies, this program might even be suitable as preventive universal intervention. A randomized effectiveness trial on community samples should be conducted to investigate this hypothesis.

Most teachers appear satisfied with the PR program as 98% of the teachers have reported that they intended to use the PR program in the future or most important elements thereof. Still, there are some changes that could be made to further improve the PR program. First, it is advised to include more information and practical tips in the manual about how to ignore undesired behavior. Ignoring undesired behavior can be very difficult for teachers, particularly if the behavior is disturbing for other students or for the teacher itself and because undesired, ignored behavior tends to increase before it will fade out. Providing teachers with more practical tools of how to put this technique into practice, while still emphasizing the importance of rewarding desired behavior, might make the PR program more effective. Second, extra support for teachers using the functional behavior assessment might be a valuable contribution. In many behavioral programs (e.g., MTA Cooperative Group, 1999; Van Den Hoofdakker et al., 2007), individual guidance is given when performing functional behavior

assessments due to the potential difficulties and pitfalls one might encounter. Therefore, online exercises for teachers to practice with functional behavior assessments and online feedback afterwards could support teachers when performing these assessments. Moreover, the manual could more explicitly mention that this technique is very difficult and that it is recommended to consult their school counselor or the help desk of the PR program in case of any doubts. A third suggestion might be to include more psycho-education in the manual regarding comorbid psychopathology (e.g., ADHD and conduct problems) and to provide extra (online) assistance for teachers of students with comorbid psychopathology, for example through the online helpdesk. Perhaps, this will increase the effectiveness of the PR program for this comorbid subgroup who currently benefit less from this program. Of course, future research would be necessary to examine whether abovementioned suggestions increase the effectiveness of the PR program, for all students or for a subgroup of students.

As this is the first study into the effectiveness of the PR program, there are still enough issues that are worth investigating in future research, some of which have been mentioned previously. First, it would be interesting to further investigate whether the effects of the PR program are limited to teachers' perception of a child's behavior, or whether beneficial effects can be found on other teacher variables (e.g. teacher-child interactions, teacher self-efficacy and knowledge of ADHD) or on other less-proximate outcomes. For example, more lengthy classroom observations during structured and unstructured classroom situations could be more appropriate to capture program-related gains on conduct problems and ADHD-related behavior such as off-task behavior (Henry & Group, 2006; Hintze & Matthews, 2004). Second, we also advise to assess effects of the PR program after a longer intervention period than the current 18 weeks. Negative peer perception is difficult to change and the current intervention period might have been too short to improve peer acceptance. Finally, the long-term program effects and the moderating and mediating effects of many interesting variables on treatment outcome are still unexplored, such as problems at home (e.g., maternal depression or marital problems) or several teacher variables (e.g., teachers' treatment expectations, treatment acceptance, and treatment fidelity). Knowledge regarding the factors influencing the effectiveness of the PR program, could help clinical and educational experts to determine the most appropriate treatment for every student.

During the last four years, many parents and teachers have expressed the need for a low-intensive behavioral parent program that can be used besides our

behavioral teacher program. Therefore, a behavioral parent program is currently being developed at the Vrije Universiteit Amsterdam to target ADHD symptoms at home. Like the PR program, the focus will be on creating a low-intensive, inexpensive program that can be used for both children with clinical ADHD, as well as for children displaying ADHD symptoms without meeting full diagnostic criteria. A comprehensive behavioral program involving both a teacher and a parent component will be a valuable expansion of the current teacher program, that may help to reduce ADHD-related problem behavior and prevent an escalation of problem behavior later in life, stigmatization, and the need for intensive, costly treatments.

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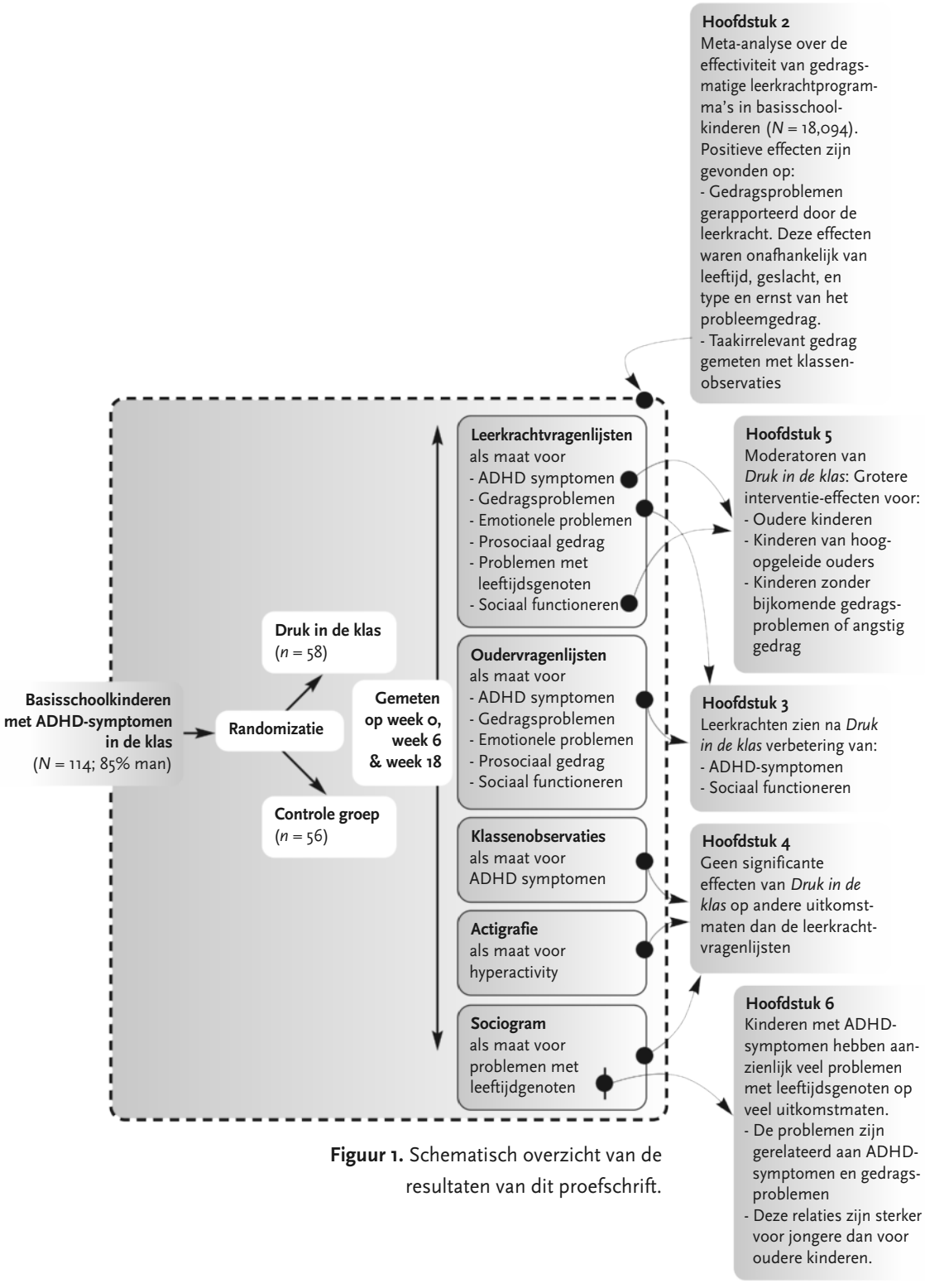
Appendices



Figuur 1. Schematisch overzicht van de resultaten van dit proefschrift.

Appendix 1 Nederlandse Samenvatting
Dutch Summary

Het hoofddoel van dit proefschrift was om de effectiviteit te onderzoeken van *Druk in de Klas*, een gedragsmatig leerkrachtprogramma gericht op de aanpak van ADHD-symptomen in de klas. Om een zo compleet mogelijk beeld te krijgen van de effectiviteit van dit programma, is er gebruik gemaakt van verschillende instrumenten (leerkracht- en oudervragenlijsten, klassenobservaties, actometers, en sociogrammen) en is er onderzoek gedaan naar moderatoren die van invloed zijn op de effectiviteit. Een aanvullend doel was om uitgebreid onderzoek te doen naar de problemen die kinderen met ADHD-symptomen ervaren met klasgenoten. De relaties van kinderen met ADHD-symptomen en diens klasgenoten is onderzocht met veel verschillende uitkomstmaten afkomstig van het sociogram (bijvoorbeeld het aantal vrienden en de populariteit van die vrienden). Daarnaast is onderzocht in hoeverre de problemen met leeftijdsgenoten gerelateerd zijn aan de ADHD-symptomen (aandachtstekort en hyperactiviteit/impulsiviteit) en ander gerelateerd probleemgedrag (gedragsproblemen, emotionele problemen en weinig prosociaal gedrag).

Allereerst zal een samenvatting worden gegeven van de hoofdbevindingen van elk hoofdstuk (zie ook Figuur 1). Vervolgens worden de bevindingen in de algemene discussie geïntegreerd en zullen de bevindingen in een bredere context worden geplaatst, waarbij relevante literatuur in acht zal worden genomen. Tenslotte komen de sterke kanten, beperkingen, implicaties voor de klinische praktijk en aanbevelingen voor toekomstig onderzoek aan bod.

Samenvatting van de Hoofdbevindingen

Hoofdstuk 2 betreft een overzichtsstudie (meta-analyse) van gerandomiseerde, gecontroleerde trials (RCT's) over de effectiviteit van gedragsmatige leerkrachtprogramma's gericht op storend gedrag (symptomen van ADHD, ODD en/of CD) in de klas. De overzichtsstudie omvat 18 RCT's gepubliceerd tussen 1980 en 2016 en betreft 18.094 basisschoolkinderen. De resultaten laten kleine, maar significante positieve effecten zien van gedragsmatige leerkrachtprogramma's op storend gedrag gerapporteerd door de leerkracht (d = -0.20) en op taakirrelevant gedrag gemeten aan de hand van klassenobservaties (d = 0.39). Er werd geen significant effect gevonden op storend gedrag zoals gemeten aan de hand van klassenobservaties. De positieve effecten op leerkracht-gerapporteerd storend gedrag waren niet gerelateerd aan leeftijd, geslacht,

soort probleemgedrag (ADHD- versus ODD/CD-symptomen) en ernst van probleemgedrag, waarbij een klinische subgroep werd vergeleken met een risicogroep (probleemgedrag zonder diagnose) en een aselecte groep (voltallige klassen en/of scholen zonder selectie op probleemgedrag). Wel bleken korte programma's effectiever dan programma's die langer duurden ($R^2 = 0.41$). Aangezien gedragsmatige leerkrachtprogramma's even effectief bleken ongeacht leeftijd, geslacht, soort en ernst van probleemgedrag, pleiten deze resultaten voor het gebruik van kosteneffectieve, universele programma's voor de hele klas als eerste stap in de aanpak van storend gedrag in de klas. Intensievere, individuele programma's kunnen dan gereserveerd worden voor kinderen die niet adequaat reageren op universele gedragsmatige programma's.

In **hoofdstuk 3** is de effectiviteit onderzocht van *Druk in de Klas* op gedragsmatig, sociaal en emotioneel functioneren (gemeten met leerkracht- en oudervragenlijsten) van kinderen met ADHD-symptomen ($N = 114$). In tegenstelling tot de meeste gedragsmatige leerkrachtprogramma's die vaak een intensieve training behoeven, omvat het zelfhulpprogramma *Druk in de Klas* geen leerkrachttraining. Het zelfhulp programma omvat zowel individuele als klassikale strategieën, waardoor het mogelijk op grote schaal kan worden geïmplementeerd tegen een voordelig tarief. *Druk in de Klas* bevat elementen van effectief bewezen gedragsmatige leerkrachtprogramma's (zoals het Amerikaanse 'Summer Treatment Program'; MTA Cooperative Group, 1999), zoals psycho-educatie voor de leerkracht, klassenmanagementstrategieën, een belonings- en time-out systeem (Pelham & Fabiano, 2008). De resultaten van de studie wijzen uit dat leerkrachten na gebruik van *Druk in de Klas* positieve effecten rapporteren op ADHD-symptomen en sociaal functioneren ($0.01 < f^2 > 0.36$) van kinderen in de interventiegroep ($n = 58$) in vergelijking met leerkrachten uit de controlegroep waar de methode niet werd gebruikt ($n = 56$). Tevens was er een significante afname van gedragsproblemen bij kinderen in de interventiegroep ten opzichte van kinderen in de controlegroep, maar dit effect verdween als gecorrigeerd werd voor gedragsproblemen bij aanvang van het programma. *Druk in de Klas* had geen effect op leerkracht-gerapporteerde emotionele problemen, problemen met leeftijdsgenoten en prosociaal gedrag. Ouders rapporteerden evenmin positieve effecten van *Druk in de Klas*, wat impliceert dat de positieve effecten op ADHD-symptomen en sociaal functioneren niet generaliseren naar de thuissituatie. De tevredenheid van leerkrachten was hoog, alsook de betrouwbaarheid waarmee de methode door leerkrachten in de klas werd toegepast. Op basis van de positieve bevindingen van deze studie, is *Druk in de Klas* een veelbelovende methode om gedrag in de klas van kinderen met ADHD-symptomen te verbeteren.

Vanwege de grote betrokkenheid van leerkrachten bij de invoer van *Druk in de Klas*, bouwt **Hoofdstuk 4** voort op Hoofdstuk 3 door te onderzoeken of de positieve effecten gerapporteerd door de leerkracht, bevestigd konden worden door middel van klassenobservaties, actometers en sociogrammen. Op deze uitkomstmaten werden geen positieve effecten gevonden van *Druk in de Klas*. Een mogelijke verklaring voor deze bevindingen is dat *Druk in de Klas* slechts de beleving van de leerkracht verbetert in plaats van het daadwerkelijke gedrag van het kind, of dat de gebruikte instrumenten onvoldoende in staat zijn om verbeteringen van het leerkrachtprogramma te registreren.

Correlationele analyses tussen leerkracht-gerapporteerde ADHD-symptomen en ADHD-symptomen gemeten middels de klassenobservatie en actigrafie, wezen geen significante correlaties uit, met één uitzondering: hyperactiviteit/impulsiviteit gerapporteerd door de leerkracht bleek matig gecorreleerd met hyperactiviteit gemeten met actigrafie (r = -0.25, p = .012). De afwezigheid van interventie effecten van *Druk in de Klas* op de uitkomstmaten gebruikt in deze studie zou dus kunnen samenhangen met de verschillende gedragsmatige aspecten die met deze instrumenten gemeten worden. Deze studie benadrukt het belang van het gebruik van verschillende uitkomstmaten bij het in kaart brengen van de effecten van (leerkracht)programma's.

Hoofdstuk 5 geeft meer inzicht in de leerkracht-gerapporteerde effecten van *Druk in de Klas* op ADHD-symptomen en sociaal functioneren door mogelijke moderatoren te onderzoeken die van invloed zouden kunnen zijn op deze interventie-effecten. De resultaten lieten zien dat het effect van *Druk in de Klas* op ADHD-symptomen groter was voor oudere kinderen en voor kinderen van hoogopgeleide ouders. Tevens bleek het effect van *Druk in de Klas* op ADHD-symptomen kleiner voor kinderen met veel ADHD-symptomen en veel angstig gedrag. Betreffende het sociaal functioneren, werden grotere interventie-effecten gevonden bij kinderen die niet erg geaccepteerd werden door klasgenoten en bij kinderen die weinig sociale vaardigheden hadden alsook weinig gedragsproblemen. Er werden geen modererende effecten gevonden voor geslacht, IQ, ernst van probleemgedrag, ervaring van de leerkracht en het aantal kinderen per klas.

Samenvattend blijkt *Druk in de Klas* effectiever voor oudere kinderen en kinderen van hoogopgeleide ouders, terwijl gedragsproblemen en angstig gedrag de positieve effecten lijken te belemmeren. Dit zelfhulpprogramma voor leerkrachten lijkt dus met name geschikt voor kinderen zonder aanvullende uitdagingen, terwijl het minder geschikt lijkt om de benodigde hulp te verschaffen aan kinderen van

laagopgeleide ouders of drukke/ongeconcentreerde kinderen met bijkomende psychische problemen. Deze bevindingen benadrukken dat *Druk in de Klas* vooral gebruikt zou moeten worden in een vroegtijdig stadium voordat probleemgedrag escaleert of zich verplaatst naar andere domeinen.

Hoofdstuk 6 onderzocht diverse aspecten van relaties van kinderen met ADHD-symptomen en hun klasgenoten, waarbij gebruik werd gemaakt van een unieke, uitgebreide set van uitkomstmaten afgeleid van het sociogram. Tevens werd nagegaan of specifiek probleemgedrag gerelateerd was aan de gevonden problemen met klasgenoten. Resultaten leveren bewijs voor substantiële relationele problemen (d = 0.25 - 0.65) van kinderen met ADHD-symptomen (N = 111; 91% zonder diagnose) met hun klasgenoten (N = 2.526). Kinderen met ADHD-symptomen hadden een lagere sociale preferentie (minder populair), hogere sociale impact, minder wederkerige vriendschappen, en ze werden vaker afgewezen en genoemd als niet-vriend. Daarnaast vonden kinderen met ADHD-symptomen hun klasgenoten leuker dan dat hun klasgenoten hen leuk vonden (negatieve disbalans). Tenslotte bleek dat kinderen met ADHD-symptomen vaker minder populaire klasgenoten als vriend kozen, terwijl de kinderen die zij als niet-vriend noemden vaker populair waren. Deze bevindingen suggereren dat kinderen met ADHD-symptomen vaker vrienden zoeken die ook minder populair zijn.

De resultaten van de studie wijzen tevens uit dat hyperactiviteit/impulsiviteit, aandachtstekort en gedragsproblemen gerelateerd zijn aan de relationele problemen met klasgenoten. De associatie van ADHD-symptomen en gedrags-problemen met de relationele problemen waren groter voor jongere kinderen dan voor oudere kinderen. Desalniettemin bleek hyperactiviteit/impulsiviteit bij oudere kinderen gerelateerd aan meer vriendschappen met andere klasgenoten die ook werden afgewezen door de meerderheid van de klas. Vanwege de substantiële relationele problemen van kinderen met ADHD-symptomen met hun klasgenoten, zijn vroegtijdige interventies voor deze kinderen (zoals *Druk in de Klas*) cruciaal en kunnen dergelijke interventies mogelijk helpen om een escalatie van probleemgedrag naar klinische ADHD te voorkomen.

Algemene Discussie

Het hoofddoel van dit proefschrift was om de effectiviteit van *Druk in de Klas* te onderzoeken. Zoals omschreven in de algemene inleiding, onderscheid *Druk in de Klas* zich van andere gedragsmatige programma's vanwege de laag-drempeligheid en de mogelijkheid voor leerkrachten om het programma te

gebruiken zonder aanvullende leerkrachttraining. Dit vergroot de kans dat het programma in de toekomst langdurig en voordelig kan worden geïmplementeerd. Een secundair doel was om uitgebreid onderzoek te doen naar de relationele problemen tussen kinderen met ADHD-symptomen en hun klasgenoten.

Hoofdbevindingen van *Druk in de Klas*

De resultaten van dit proefschrift laten zien dat leerkrachten na gebruik van *Druk in de Klas* een kleine, maar significante verbetering merkten bij hun leerling(en) in termen van ADHD-symptomen en sociaal functioneren (Hoofdstuk 3). Deze resultaten zijn grotendeels in overeenstemming met het bewijs uit onze overzichtsstudie waar kleine, positieve effecten werden gevonden van gedragsmatige leerkrachtprogramma's op ADHD- en ODD/CD-symptomen zoals gerapporteerd door de leerkracht (Hoofdstuk 2). Echter, in tegenstelling tot onze overzichtsstudie, werden geen significante effecten gevonden van *Druk in de Klas* op gedragsproblemen wanneer gecontroleerd werd voor de ernst van gedragsproblemen bij aanvang van het programma (Hoofdstuk 3). Er werden evenmin significante effecten gevonden van het programma op problemen met klasgenoten zoals gerapporteerd door de leerkracht (Hoofdstuk 3).

De positieve interventie-effecten op ADHD-symptomen en sociaal functioneren gerapporteerd door de leerkracht werden helaas niet bevestigd met andere instrumenten (actometers, klassenobservaties en sociogrammen; zie Hoofdstuk 4). Dit is in overeenstemming met twee overzichtsstudies waar kleine, positieve effecten werden gevonden van gedragsmatige programma's op leerkrachtgerapporteerd ADHD-symptomen, terwijl er met klassenobservaties geen effecten werden gevonden op ADHD-symptomen of ander storend gedrag (Sonuga-Barke et al., 2013 en Hoofdstuk 2, maar zie ook MTA Cooperative Group, 1999).

De resultaten van Hoofdstuk 3 en 4 zouden erop kunnen duiden dat de positieve effecten gerapporteerd door de leerkracht slechts de beleving van leerkrachten over het functioneren van diens leerling(en) verbeterden, in plaats van het daadwerkelijke gedrag van het kind. Een mogelijke verklaring hiervoor is dat leerkrachten bevooroordeeld waren doordat ze positieve verwachtingen hadden van het programma of door de tijd en energie die ze in het programma hadden gestoken (Sonuga-Barke et al., 2013). Het is ook mogelijk dat ze de ADHD-symptomen meer tolereerden of er beter mee om konden gaan (Daley et al., 2014), bijvoorbeeld vanwege de voorlichting welke een positieve houding en positief gedrag tegen mensen met ADHD kan bevorderen (Nussey, Pistrang, & Murphy, 2013).

Er zijn echter ook andere mogelijke verklaringen voor de huidige tegenstrijdige bevindingen (positieve effecten gerapporteerd door de leerkracht, welke niet bevestigd worden door andere instrumenten). Vanwege de lage correlaties tussen de leerkracht-gerapporteerde ADHD-symptomen en andere ADHD-uitkomstmaten (klassenobservaties en actigrafie; Hoofdstuk 4), is het mogelijk dat de instrumenten verschillende aspecten van gedrag meten. Daarnaast kan het zijn dat klassenobservaties en actometers niet in staat waren om de positieve effecten van *Druk in de Klas* te registreren vanwege beperkingen van deze instrumenten zelf (zie discussie van Hoofdstuk 4). De duur van de klassenobservaties kan bijvoorbeeld te kort zijn geweest (2 x 8 minuten) om mogelijke gedragsverbeteringen op te merken. Een voorbeeld van een beperking van de actometer is dat deze geen onderscheid kan maken tussen ongewenste hyperactiviteit en gewenste bewegingen, zoals de hand opsteken voordat men een vraag stelt.

Hoewel leerkrachten na gebruik van *Druk in de Klas* een verbetering rapporteerden in het sociaal functioneren van hun leerling(en) (Hoofdstuk 3), merkten leerkrachten en klasgenoten geen verbetering in de relaties met klasgenoten (Hoofdstuk 3 en 4). Deze bevindingen suggereren dat *Druk in de Klas* sociaal gedrag naar leerkrachten verbetert, maar niet sociaal gedrag naar klasgenoten. Dit is plausibel aangezien interacties tussen leerkracht en leerling meer onderwijsgerelateerd zijn dan sociale interacties tussen klasgenoten (Baker, 2006), en leerkrachten wellicht meer gefocust waren op het verbeteren van storend gedrag tijdens instructies en lessen, dan op gedrag dat storend is in sociale interacties met klasgenoten.

Het is echter ook mogelijk dat het negatieve gedrag van participanten richting klasgenoten wel was afgenomen, zonder dat de klasgenoten hun negatieve mening bijstelden. Literatuur laat namelijk zien dat afwijzing door leeftijdsgenoten moeilijk verandert, zelfs als negatief gedrag van het afgewezen kind verbetert (Mrug, Hoza, Pelham, Gnagy, & Greiner, 2007). Een stabiele negatieve mening van klasgenoten wordt mogelijk verklaard door negatieve verwachtingen van klasgenoten. Dit kan leiden tot negatief of ambivalent gedrag van klasgenoten richting het impopulaire kind en kan daardoor gedragsverbetering van het impopulaire kind belemmeren (Harris, Milich, Corbitt, Hoover, & Brady, 1992). Een andere mogelijke verklaring is dat klasgenoten gedragsverbetering van het impopulaire kind toekennen aan externe factoren (zoals anderen die aardig doen) of instabiele factoren (zoals het humeur van een kind; Hymel, 1986). Kortom, de interventieperiode van 18 weken was wellicht te kort om de

negatieve mening van klasgenoten over participanten met ADHD-symptomen te verbeteren.

Hoewel alleen leerkrachten positieve effecten merkten van *Druk in de Klas*, moet het belang van het verbeteren van de beleving van de leerkracht niet worden onderschat. Als een leerkracht immers de beleving heeft dat het gedrag van een leerling verbetert, dan kan dit ook het gedrag van de leerkracht naar dit kind verbeteren en aldus zorgen voor een positievere interactie tussen beiden (Stuhlman & Pianta, 2002). Bovendien kan een positieve leerkracht-leerling interactie zorgen voor een verbeterd schools functioneren en betere schoolprestaties, door het aanwakkeren van motivatie, betrokkenheid bij schoolse activiteiten en bij het ontwikkelen van sociale en gedragsmatige competenties (Pianta, 1999). Een goede relatie tussen leerkracht en leerling kan extra belangrijk zijn voor kinderen die storend gedrag in de klas vertonen (zoals ADHD-symptomen) aangezien zij vaak negatieve feedback ontvangen van leerkrachten en klasgenoten. Aangezien leerkracht-leerling interactie niet als uitkomstmaat is meegenomen in deze studie, is toekomstig onderzoek nodig om te onderzoeken of *Druk in de Klas* daadwerkelijk een positief effect heeft op leerkracht-leerling interacties.

Men zou kunnen beargumenteren dat extra ondersteuning van experts de effectiviteit van *Druk in de Klas* zouden kunnen verbeteren, maar literatuur is hier inconsistent over. Een review over de effectiviteit van zelfhulpprogramma's voor ouders van kinderen met gedragsproblemen suggereert dat minimale ondersteuning van een therapeut het gedrag van kinderen verbetert (O'Brien & Daley, 2011). Een andere overzichtsstudie suggereert echter dat zelfhulp-programma's voor ouders even effectief zijn als ouderprogramma's die door therapeuten worden verzorgd (Tarver, Daley, Lockwood, & Sayal, 2014). Toekomstig onderzoek is nodig om te onderzoeken of de effectiviteit van *Druk in de Klas* kan worden vergroot door betrokkenheid van experts.

Invloed van Moderatoren op de Effectiviteit van *Druk in de Klas*

Zoals besproken in Hoofdstuk 5, waren de positieve effecten van *Druk in de Klas* op leerkracht-gerapporteerde ADHD-symptomen groter voor oudere kinderen, kinderen uit hoger-opgeleide gezinnen en kinderen zonder ernstige bijkomende gedragsproblemen of angstig gedrag. Deze bevindingen komen overeen met onze verwachting dat dit laagdrempelige zelfhulpprogramma effectief is voor de groep kinderen met ADHD-symptomen zonder extra uitdagingen, terwijl meer intensieve, individuele begeleiding nodig lijkt voor kinderen van lager-opgeleide ouders of met ernstige bijkomende gedragsproblemen (van den Hoofdakker, et

al., 2010). Vooral bijkomende gedragsproblemen lijken de positieve effecten te belemmeren aangezien de huidige bevindingen laten zien dat gedragsproblemen niet verminderen na gebruik van *Druk in de Klas* (Hoofdstuk 3). Bovendien blijkt het effect van het programma op ADHD-symptomen en sociaal functioneren eveneens kleiner in geval van bijkomende gedragsproblemen (Hoofdstuk 6). Er werden geen modererende effecten gevonden van geslacht, IQ en ernst van probleemgedrag. Dit betekent dat de effectiviteit van *Druk in de Klas* niet afhankelijk lijkt van geslacht, IQ en ernst van probleemgedrag, hetgeen grotendeels in lijn is met onze overzichtsstudie waar evenmin modererende effecten werden gevonden van geslacht en ernst van gedragsproblemen (Hoofdstuk 2).

Het modererende effect van leeftijd dat in deze studie is gevonden, komt overeen met andere studies waar eveneens voor oudere kinderen grotere effecten werden gevonden van gedragsmatige programma's dan voor jongere kinderen (Comer, Chow, Chan, Cooper-Vince, & Wilson, 2013; van den Hoofdakker et al., 2010), maar komen niet overeen met de resultaten van onze overzichtsstudie (Hoofdstuk 2). Wellicht konden oudere kinderen hun impulsen makkelijker bedwingen dan jongere kinderen en konden zij zich makkelijker schikken naar de nieuwe regels en aanpassingen die de leerkracht in het kader van *Druk in de Klas* had doorgevoerd. Immers, de ontwikkeling van de hersenen alsook socialisatie verbetert naarmate kinderen ouder worden (Faraone, Biederman, & Mick, 2006).

De bevinding dat *Druk in de Klas* effectiever is voor kinderen van hoogopgeleide ouders komt overeen met enkele reviews naar de predictoren en moderatoren van gedragsmatige programma's op het gedrag van kinderen met ADHD (Chronis, Jones, & Raggi, 2006; Hoza, Johnston, Pillow, & Ascough, 2006). Ouders waren veelal betrokken bij de uitrol van veel van deze behandelingen (zoals medicatie en ouderprogramma's) en de invloed van opleidingsniveau op de effectiviteit kon worden verklaard door de grotere betrokkenheid en therapietrouw van hoogopgeleide ouders (La Greca, Silverman, & Lochman, 2009). Deze verklaring is minder waarschijnlijk in onze studie waar ouders niet betrokken waren bij de invoer van het programma in de klas. Een meer waarschijnlijke verklaring voor de grotere interventie-effecten voor hoogopgeleide ouders in onze studie zou gerelateerd kunnen zijn aan de houding en verwachtingen van leerkrachten. Leerkrachten hebben vaak een minder positieve indruk van kinderen uit gezinnen met een lage sociaal economische status (SES; vaak gemeten met opleidingsniveau van ouders) en hebben lagere

verwachtingen van deze kinderen in termen van academisch of gedragsmatig functioneren (McLoyd, 1998). Het is derhalve mogelijk dat leerkrachten ook minder effect van *Druk in de Klas* verwachten bij deze kinderen.

Hoewel de huidige resultaten erop wijzen dat *Druk in de Klas* even effectief is voor de meeste drukke, impulsieve en ongeconcentreerde kinderen, ongeacht de ernst van de ADHD-symptomen, lijken kinderen met bijkomende gedragsproblemen of angstig gedrag minder baat te hebben bij dit programma. Zo bleek er geen verbetering in termen van ADHD-symptomen voor angstige kinderen met veel ADHD-symptomen, terwijl er een grote verbetering zichtbaar was bij niet-angstige kinderen met veel ADHD-symptomen. De reden dat andere studies juist grotere positieve effecten vinden bij kinderen met ADHD en bijkomende angstproblemen (March et al., 2000; van den Hoofdakker et al., 2010; Van der Oord, Prins, Oosterlaan, & Emmelkamp, 2008), zou gerelateerd kunnen zijn aan de grotere betrokkenheid van ouders in die programma's. Ouders van kinderen met ADHD en bijkomende angstproblemen zijn wellicht sneller overbezorgd en beschermend naar hun kinderen dan ouders van kinderen zonder angstig gedrag (Pfiffner & McBurnett, 2006). Tevens zijn zij wellicht meer geneigd om richtlijnen uit behandelingsprotocollen nauw op te volgen (Van der Oord, et al., 2008), hetgeen zou kunnen resulteren in grotere interventie-effecten. In ons zelfhulpprogramma voor leerkrachten waren ouders helemaal niet betrokken bij de invoer van de methode in de klas. Dit zou de verschillen tussen onze resultaten en eerdere literatuur kunnen verklaren. Wellicht zijn de kleinere effecten van *Druk in de Klas* voor angstige deelnemers gerelateerd aan de beleving van leerkrachten. Angstige kinderen zijn geneigd om veel hulp en toenadering te zoeken bij hun leerkracht. De leerkracht zou het kind daardoor als lastig kunnen ervaren, wat voor frustratie zou kunnen zorgen bij de leerkracht (Pianta & Nimetz, 1991). De behandeleffecten van *Druk in de Klas* voor angstige kinderen zou daardoor kleiner kunnen zijn. Leerkrachten meer informatie geven over bijkomende internaliserende (naar binnen gerichte) en externaliserende (naar buiten gerichte) problemen bij kinderen met ADHD en aanvullende leerkracht-ondersteuning zou kunnen bijdragen aan het vergroten van de effectiviteit van *Druk in de Klas* voor kinderen met bijkomende gedragsproblemen (Gillberg, et al., 2004).

Gebaseerd op de bevindingen van dit proefschrift lijkt het laagdrempelige leerkrachtprogramma *Druk in de Klas* een veelbelovende methode voor kinderen met ADHD-symptomen zonder aanvullende uitdagingen. Toekomstig onderzoek is echter noodzakelijk om te onderzoeken of andere instrumenten anders dan leerkrachtvragenlijsten de positieve behandeleffecten van *Druk in de Klas* kunnen

bevestigen. Desalniettemin heeft *Druk in de Klas,* dankzij de lage kosten en laagdrempeligheid in vergelijking met andere intensievere programma's, de potentie om succesvol en grootschalig te worden geïmplementeerd.

Problemen met Leeftijdsgenoten

In Hoofdstuk 6 wordt bewijs geleverd voor substantiële problemen van kinderen met ADHD-symptomen met hun klasgenoten. Zo zijn ze minder populair, worden ze vaker afgewezen, hebben ze minder vrienden en de vrienden die ze hebben zijn veelal minder geliefd. Meer problemen met leeftijdsgenoten bleek gerelateerd aan meer aandachtstekort, hyperactiviteit/impulsiviteit en bijkomende gedragsproblemen en deze relatie bleek sterker bij jongere kinderen dan bij oudere kinderen. Bij oudere kinderen was hyperactiviteit/impulsiviteit ook gerelateerd aan meer vriendschappen met andere impopulaire kinderen. Literatuur laat zien dat afwijzing door klasgenoten geassocieerd is met een groter negatief zelfbeeld (Ladd & Troop Gordon, 2003) en meer aanpassingsproblemen van kinderen met ADHD, terwijl dit het risico op negatieve lange termijneffecten vergroot zoals problemen op school, gezondheidsproblemen en crimineel gedrag (Mikami & Hinshaw, 2006; Murray-Close et al., 2010; Parker, Rubin, Erath, Wojslawowicz, & Buskirk, 2006). Gegeven de substantiële sociale problemen die kinderen met ADHD-symptomen ervaren met klasgenoten (Hoofdstuk 6) en de negatieve effecten van deze problemen, is het erg belangrijk dat de sociale vaardigheden van deze kinderen worden verbeterd. Specifieke interventies gericht op het verbeteren van de relaties tussen klasgenoten, zoals de interventie 'Making Socially Accepting Inclusive Classrooms' (MOSAIC; Mikami et al., 2013), kunnen mogelijk helpen om positieve relaties tussen kinderen met ADHD-symptomen en hun klasgenoten te bevorderen.

Sterke kanten en Beperkingen

Deze studie is uniek omdat het de effectiviteit onderzoekt van een gedragsmatig leerkrachtprogramma dat laagdrempeliger is dan soortgelijke programma's welke meestal een dure, intensieve leerkrachttraining bevatten. Dergelijke intensieve programma's kunnen vaak lastig worden geïmplementeerd op de lange termijn vanwege een gebrek aan financiële middelen na afloop van het onderzoek. *Druk in de Klas* is dan ook van toegevoegde waarde ten opzichte van bestaande programma's dankzij de mogelijkheid om de methode landelijk op grote schaal te implementeren tegen een schappelijke prijs. De hoge tevredenheid en protocolnaleving vergroot de kans dat dit programma succesvol kan zijn op de lange termijn. Naleving van het protocol werd echter gemeten middels zelfrapportage door de leerkracht in plaats van onafhankelijke klassen-

observaties, maar het gebruik van klassenobservaties was helaas niet haalbaar in deze studie vanwege praktische beperkingen in tijd en geld. Toekomstig onderzoek is noodzakelijk om te onderzoeken of de hoge naleving van het protocol zoals gemeten met de zelfrapportage kan worden bevestigd door klassenobservaties.

Een andere kracht van deze studie is het gebruik van actometers, klassenobservaties en sociogrammen om de effectiviteit van *Druk in de Klas* te onderzoeken. Het aantal gerandomiseerde, gecontroleerde studies (RCT' s) dat deze instrumenten voorheen voor deze doeleinden heeft gebruikt is zeer beperkt. Klassenobservaties en sociogrammen werden slechts twee keer eerder gebruikt om de effectiviteit van gedragsmatige leerkrachtprogramma's te onderzoeken (Miranda, Presentación, & Soriano, 2002; MTA Cooperative Group, 1999; Pelham et al., 1993), en geen enkele studie gebruikte eerder actometers. Naast de positieve bevindingen gerapporteerd door de leerkracht, zijn er geen positieve effecten gevonden van *Druk in de Klas* op deze instrumenten. Desalniettemin is het van groot belang om ook deze bevindingen te rapporteren, zodat inzichtelijk is wat de reikwijdte is van de effectiviteit van het programma. Toekomstige effectiviteitsstudies worden dan ook aangemoedigd om naast vragenlijsten ook andere instrumenten te gebruiken om de effectiviteit van programma's in kaart te brengen.

Met betrekking tot de klassenobservaties zijn er twee belangrijke beperkingen die genoemd dienen te worden. Om te beginnen waren de observatoren in deze studie zich bewust van de conditie waaraan deelnemers waren toebedeeld (controle of interventiegroep), doordat sommige elementen uit *Druk in de Klas* zichtbaar waren in het klaslokaal. Het is echter niet waarschijnlijk dat dit de huidige resultaten heeft beïnvloed, aangezien er geen positieve effecten zijn gevonden op deze uitkomstmaat. Daarnaast konden de effecten van *Druk in de Klas* op gedragsproblemen niet onderzocht worden middels de klassenobservaties, omdat er weinig agressief gedrag plaatsvond gedurende de klassenobservaties. Wellicht zijn langere observaties of observaties gedurende ongestructureerde momenten (zoals pauze, gym of schakelmomenten) noodzakelijk om agressie op school beter in kaart te brengen. Helaas zijn dergelijke observaties erg tijdrovend en duur en daarom waren dergelijke observaties niet haalbaar in deze studie.

Een andere beperking van deze studie is dat de leerkracht-leerling interactie niet als uitkomstmaat is meegenomen. Hierdoor was het onmogelijk om te

onderzoeken of *Druk in de Klas* heeft geresulteerd in een verbeterde interactie tussen de leerkracht en diens leerling met ADHD-symptomen. Dit zou de toegevoegde waarde van de huidige studie hebben vergroot, zeker omdat alleen leerkrachten positieve interventie-effecten rapporteren. Aangezien leerkrachten een verbetering merkten van het gedrag van hun leerling, is het waarschijnlijk dat de leerkracht meer positieve feedback gaf aan dit kind, hetgeen mogelijk de leerkracht-leerling interactie heeft verbeterd (Stuhlman & Pianta, 2002). Toekomstig onderzoek zal echter moeten uitwijzen of deze hypothese daadwerkelijk klopt.

Daarnaast zijn in de huidige RCT de verwachtingseffecten van leerkrachten en ouders niet onderzocht, waardoor het onmogelijk was om te onderzoeken of de positieve effecten gerapporteerd door de leerkracht (welke niet bevestigd werden door andere uitkomstmaten) verklaard kunnen worden door positieve verwachtingen van leerkrachten in de interventiegroep over de effectiviteit van *Druk in de Klas*.

De ongelijke verdeling tussen jongens en meisjes in onze onderzoeksgroep (84% was jongen) zorgt ervoor dat leerkracht-gerapporteerde effecten van *Druk in de Klas* niet gegeneraliseerd kunnen worden naar meisjes. Om diezelfde reden is tevens voorzichtigheid geboden bij de conclusie dat de methode even effectief is voor jongens als voor meisjes. De ongelijke verdeling in geslacht komt veel voor in ADHD-onderzoek, waar jongens duidelijk oververtegenwoordigd zijn (Gershon & Gershon, 2002). Het gebruik van aselecte onderzoeksgroepen in effectiviteitsstudies (waarbij alle kinderen uit bijvoorbeeld een klas of school worden geïncludeerd) kan helpen om de effectiviteit van gedragsmatige programma's voor meisjes met ADHD-symptomen nader te onderzoeken en te verifiëren of de vatbaarheid voor deze programma's afhankelijk is van geslacht.

Ten slotte was er, vanwege de relatief kleine groep deelnemers aan deze studie ($N = 114$), weinig power (vermogen) om significante moderatoren te detecteren die de effectiviteit van de methode beïnvloedden (Hoofdstuk 5). Deze beperking kan vooral problematisch zijn bij driewegsinteracties, zoals de modererende effecten van bijkomende psychische problemen (bijvoorbeeld groep x ADHD-symptomen x gedragsproblemen). Echter, ondanks de beperkte power, zijn er enkele significante ($\alpha < .05$) driewegsinteracties gevonden (bijvoorbeeld groep x ADHD-symptomen x angstproblemen).

Klinische Implicaties en Toekomstig Onderzoek

Gebaseerd op de huidige bevindingen lijkt *Druk in de Klas* een veelbelovende interventie voor veel kinderen met ADHD-symptomen op school, vooral voor kinderen van hoogopgeleide ouders en kinderen zonder bijkomende gedragsproblemen. De effecten van de methode waren echter klein, zoals vaak het geval is bij gedragsmatige interventies (Sonuga-Barke, et al., 2013). Om storend gedrag in de klas of gedrag in de thuissituatie te verbeteren, kan het derhalve noodzakelijk zijn om naast *Druk in de Klas* andere behandelingen te gebruiken, zoals een gedragsmatig ouderprogramma of medicatie.

Laagdrempelige kosteneffectieve programma's, zoals *Druk in de Klas*, kunnen erg waardevol zijn voor leerkrachten en scholen. Sinds de invoer van het Passend Onderwijs in Nederland, hebben reguliere basisscholen de verantwoordelijkheid om kinderen met psychiatrische of leerstoornissen, indien mogelijk, binnen hun school les te geven. Deze verplichting vereist adequate kennis en vaardigheden van leerkrachten om met veel verschillende probleemgedragingen (zoals ADHD-symptomen) om te gaan. Veel leerkrachten rapporteren echter dat zij onvoldoende kennis hebben over ADHD en dat zij zich onvoldoende capabel voelen om ADHD-symptomen in de klas adequaat aan te pakken. (Moldavsky & Sayal, 2013; Rose, Gallup, Welburn, & Hess, 2005). Tegelijkertijd is de werkdruk van leerkrachten hoog en zijn de klassen vaak groot, wat het risico op burn-out onder leerkrachten vergroot (Hakanen, Bakker, & Schaufeli, 2006; Kyriacou, 2001). Voordelige laagdrempelige programma's die geschikt zijn voor grote groepen kinderen zouden derhalve waardevol kunnen zijn voor veel leerkrachten. Aangezien *Druk in de Klas* strategieën bevat voor de hele klas en voor individuele kinderen, zou dit programma mogelijk ook geschikt zijn als preventieve, klassikale interventie. Een effectiviteitsstudie binnen voltallige klassen en/of scholen, zonder selectie op probleemgedrag (populatie sample), is echter noodzakelijk om deze hypothese te onderzoeken.

De meeste leerkrachten waren tevreden over *Druk in de Klas*, aangezien 98% van de leerkrachten aangaven (belangrijke onderdelen van) de methode in de toekomst te willen gebruiken. Er zijn echter enkele aanpassingen die de methode verder zouden kunnen verbeteren. Ten eerste is het raadzaam om meer informatie en praktische tips in de handleiding op te nemen over hoe ongewenst gedrag adequaat genegeerd kan worden. Het negeren van ongewenst gedrag kan in de praktijk erg lastig zijn voor leerkrachten, vooral als het gedrag storend is voor andere leerlingen of voor de leerkracht. Het feit dat ongewenst gedrag dat genegeerd wordt vaak eerst toeneemt voordat het afneemt, maakt negeren een

extra lastige techniek. *Druk in de Klas* zou wellicht nog effectiever zijn als het meer praktische tips bevat over de manier waarop negeren in de praktijk kan worden toegepast. De nadruk van de methode op het belonen van gewenst gedrag blijft echter essentieel om gewenst gedrag te bevorderen.

Ten tweede zou extra ondersteuning voor leerkrachten bij het gebruik van de functionele gedragsanalyse een waardevolle toevoeging zijn aan het huidige programma. In veel gedragsmatige programma's wordt individuele begeleiding gegeven bij gebruik van de functionele gedragsanalyses (MTA Cooperative Group, 1999; Van Den Hoofdakker et al., 2007), vanwege de mogelijke moeilijkheden en valkuilen waar men tegenaan kan lopen. Online-oefeningen voor leerkrachten om te oefenen met functionele gedragsanalyses en online feedback achteraf zou leerkrachten kunnen ondersteunen bij het gebruik van deze techniek. Daarnaast zou in de handleiding extra benadrukt kunnen worden dat deze techniek erg lastig is en dat het raadzaam is om bij twijfel de intern begeleider van de school of de helpdesk van *Druk in de Klas* te raadplegen. Een derde suggestie is om meer psycho-educatie in de handleiding op te nemen over bijkomende psychische problemen (zoals ADHD en gedragsproblemen) en om extra ondersteuning aan te bieden voor leerkrachten van leerlingen met deze extra lastige uitdagingen, bijvoorbeeld via de online helpdesk. Wellicht kan dit de effectiviteit van *Druk in de Klas* voor deze groep verbeteren, die momenteel minder baat heeft bij dit programma. Uiteraard is toekomstig onderzoek nodig om te onderzoeken of bovenstaande suggesties de effectiviteit van *Druk in de Klas* (voor een deel van de kinderen) vergroot.

Aangezien dit de eerste studie is naar de effectiviteit van *Druk in de Klas*, zijn er nog genoeg zaken die toekomstig onderzoek moet uitwijzen. Allereerst zou het interessant zijn om na te gaan of *Druk in de Klas* alleen de beleving van leerkrachten over het daadwerkelijke gedrag van hun leerling(en) verbetert, of dat positieve effecten kunnen worden gevonden op andere leerkrachtvariabelen (zoals leerkracht-leerling interactie, competentiebeleving van leerkrachten of diens kennis over ADHD) of op uitkomstmaten waarbij verwachtingen van de leerkracht geen rol spelen, of die onafhankelijk zijn van de inzet van een leerkracht. Wellicht zijn langere klassenobservaties tijdens gestructureerde en ongestructureerde klassensituaties meer geschikt om interventie-effecten te registreren op gedragsproblemen en ADHD-gerelateerd gedrag, zoals taakirrelevant gedrag (Henry & Group, 2006; Hintze & Matthews, 2004). Daarnaast adviseren we om de effecten van *Druk in de Klas* te onderzoeken over een langere periode dan de huidige 18 weken in deze studie. Een negatieve mening van klasgenoten over een medeleerling is lastig te veranderen en de huidige interventie-

periode was wellicht te kort om acceptatie van klasgenoten te verbeteren. Ten slotte zijn de langetermijn effecten en de modererende en mediërende effecten van veel interessante variabelen op de uitkomstmaten nog niet onderzocht, zoals problemen in de thuissituatie (bijvoorbeeld depressie van de moeder of huwelijksproblemen) of verschillende leerkrachtvariabelen (zoals verwachtingseffecten, acceptatie van het programma en naleving van het behandelprotocol). Kennis over factoren die de effectiviteit van *Druk in de Klas* kunnen beinvloeden kunnen klinische en onderwijsexperts helpen bepalen welke behandeling het meest geschikt is voor welke leerling.

Gedurende de afgelopen jaren hebben veel ouders en leerkrachten aangegeven dat er behoefte is aan een laagdrempelig gedragsmatig ouderprogramma dat naast ons leerkrachtprogramma kan worden ingezet. Derhalve wordt er bij de Vrije Universiteit momenteel een gedragsmatig ouderprogramma ontwikkeld om ADHD-symptomen in de thuissituatie aan te pakken. Net als *Druk in de Klas*, zal de focus liggen op het ontwikkelen van een laagdrempelig, voordelig programma dat geschikt is voor alle kinderen met druk en ongeconcentreerd gedrag, ongeacht de aanwezigheid van een diagnose ADHD. Een gedragsmatige methode bestaande uit een ouder- en leerkrachtcomponent zal een waardevolle uitbreiding zijn van het huidige leerkrachtprogramma, waarmee ADHD-gerelateerd probleemgedrag verder zou kunnen worden verminderd en een escalatie van probleemgedrag, stigmatisering en de inzet van dure, intensieve behandelingen mogelijk ook kan worden tegengegaan.

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Appendix 3 **About the author**

Betty Veenman was born on September 25th, 1984 in Bussum. After completing her gymnasium in 2002 (St. Vituscollege, Bussum), she first went to Salamanca (Spain) to learn Spanish. With an interest in human behavior, behavior problems and law enforcement, Betty decided to study law at the VU University Amsterdam. In 2008 she finished her master Law and Politics of International Security (cum laude), after which she was keen on pursuing her interest in the human behavior and neuropsychopathology. Betty studied psychology at the VU University Amsterdam and received her master's degree at the department of Clinical Neuropsychology (cum laude) in 2012. Her master thesis focused on attention problems in children with traumatic brain injury.

Given her continued interest in attention problems in children, Betty decided to work as a Ph.D. candidate studying the effectiveness of the Positivity & Rules program (PR program; *Druk in de Klas*), a low-level behavioral teacher program for children with ADHD symptoms. From 2012 to 2015, Betty and her students tested many children with great enthusiasm. While finishing her dissertation in 2016, Betty coordinated the implementation of the PR program and started developing a similar behavioral self-help program for parents that can be used besides the PR program.

Given her growing desire to work with children in the clinical field, Betty started working at Accare in 2018. For three days a week, she works in the polyclinic in Zwolle with children with developmental and behavioral problems. Besides that, Betty coordinates an academic project ('Academische Werkplaats voor ADHD en Druk Gedrag) focusing on improving healthcare for children with ADHD symptoms. By combining her scientific knowledge and experience with her clinical ambitions, she strives to contribute to high-quality care for all children in need of extra help, regardless of the existence of a diagnostic classification.

LIST OF PUBLICATIONS

- Veenman, B., Luman, M., Hoeksma, J., Pieterse, K., & Oosterlaan, J. (2016). A Randomized Effectiveness Trial of a Behavioral Teacher Program Targeting ADHD Symptoms. *Journal of attention disorders*. doi: 10.1177/1087054716658124.

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